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ABSTRACT

This report, the third in a series of five reports of the Comparative Study of Population Growth and Agricultural Change, describes a study of the two states of India (Punjaband and Orissa) which attempted to clarify the relationship between population pressure and agricultural change through a time series analysis. This study: (1) outlines trends in population growth and analyzes the components; (2) presents trends in agricultural growth, including changes in area, productivity, and crop patterns; (3) investigates the interrelationship between population growth and agriculture; and (4) analyzes the impact of population growth and movements on economic efficiency and welfare. A summary of the study concludes this report. A series of tables containing demographic and agricultural data, and information relevant to the study is appended. (BT)

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COMPARATIVE STUDY OF POPULATION GROWTH AND AGRICULTURAL CHANGE

C CASE STUDY OF INDIA

ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC
BANGKOK, THAILAND, 1975

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(A) : The Inter-Country Report

(B) : Case Study : Japan

(C) : Case Study : India

(D) : Case Study : Sri Lanka

(E) : A Survey of the Philippines and Thailand Data.

PREFACE

This study was undertaken as a partial compliance with Resolution 74 (XXIII) of 1967 of the Economic Commission for Asia and the Far East in which the Executive Secretary was requested to explore the effect of the population pressure in delaying the achievement of development goals. This request was prompted by the recommendations of Asian Population Conference, held in New Delhi in 1963. The study was designed to assist in clarifying the relation between population pressure and agriculture change through time series analysis with an ultimate objective of providing better understanding for setting development goals.

The detailed proposal for the study was prepared by Professor Richard A. Easterlin of the University of Pennsylvania, and it was reviewed by an *ad hoc* group of experts in Paris, 1-2 September 1969 at the OECD Development Centre. The proposal was also discussed with the FAO representatives separately. The undertaking of this study became possible through funds granted by the United Nations Fund for Population Activities. Consultants for the study were Mr. N.V. Sovani and Mr. Kim Atkinson.

First, the feasibility of launching the country studies was examined in terms of availability of population and agricultural data. Consequently, it was decided to undertake full-scale country studies in India, Japan and Sri Lanka. For the Philippines and Thailand, it was found that data in sufficient detail were not available. Therefore, it was decided to prepare only brief feasibility reports on these two countries.

The present report on India was undertaken by a study team led by Dr. J.N. Sinha, Senior Fellow, Institute of Economic Growth, Delhi in collaboration with Mr. S.P. Jain, former Director of International Institute for Population Studies, Bombay. Miss Chander Prabha and Mr. J.P. Singh offered their assistance in the analysis of the data. In addition, the Office of Registrar General, Government of India, helped by providing the unpublished data from the 1971 census. The Directorates of Health provided data on vital statistics and of Agriculture and State Bureaus provided access to land records and other sources of agricultural data. The assistance of these persons and organizations and co-operation of the Government of India are gratefully acknowledged.

This report on India is the third in the series of five reports of the Comparative Study of Population Growth and Agricultural Change.

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INTRODUCTION

India shares with other less developed countries the trend towards rapid population growth following the spread of modern techniques of disease control, availability of inexpensive sulpha and antibiotic drugs and improved measures of public health. This trend was not accompanied, however, by any significant change in the structure of the economy. Even today, agriculture continues to absorb over two-thirds of the total work force. Analysis of the process of reciprocal adaptation between agriculture and population acquires special significance in this context. The forces of change may emanate from either source. Since the scope for colonization and settlement of new lands is rather limited, the effects of growing population pressure on crop pattern and technical progress in agriculture deserve thorough investigation. Changes in demographic variables may be no less important. People may move from areas of high population pressure to those which offer new opportunities for agricultural development or alter their fertility patterns in response to new economic-demographic balance. The present study aims at analysing the patterns of association between population and agricultural change and, as far as the available data permit, the nature and direction of causality between the two variables.

India was under British rule for more than a century and a half, up to 1947. During the British period, the Indian economy was virtually stagnant. However, changes in property rights and some improvements in infrastructure were introduced. The development of irrigation systems in parts of the country and improvements in public health were also undertaken during this time. These had obvious implications for both agriculture and population. In particular, abnormal mortality due to famines and epidemics was eliminated and, since 1921, the growth of the country's population has been uninterrupted.

The year 1951 marks a dividing line in the economic history of India. It saw the advent of a new system of planning in which the state played a direct role in land reclamation, water development, road construction, supply of electricity and extension services, all of which made a sizable contribution to the growth of agriculture. Health and medical services were also rapidly developed, resulting in a sharp decline in mortality and accelerated growth of population. However, the impact of these developments was not evenly felt in all parts of the country. Cross-sectional and cross-temporal comparisons between different parts of the country, therefore, provide an interesting basis for the study of interrelationships between demographic and agricultural variables.

India is a vast subcontinent with extreme heterogeneity in terms of resource availabilities and socio-cultural traditions which influence the pace and pattern of development. It was not possible to cover the entire country for an in-depth study of the relationship between population growth and agricultural change within the limited time. It was therefore decided to restrict the study to two states - Punjab and Orissa. The choice was purposive: they offer a sharp contrast between changes in population and agriculture. Punjab is well-known for relatively high levels of development in terms of both material prosperity and the quality of human resources. Orissa has been economically backward. The unit of study is the district and the analysis is based on inter district comparisons of population and agricultural change. Some points of interest are also expected to emerge from comparison between the two states.

Prior to Independence, the country had a dual administrative structure, one of districts directly under British rule and the other of areas under princely states. After Independence, the latter were merged with the former British area and reconstituted into uniform administrative units. The geographical coverage before 1951, however, is confined to the districts of former British India. This is partly because not all the data for the former princely states are available. They did not maintain regular statistics on agriculture. Further, the geographical comparability between the reconstituted districts and the units of area which comprised them is such that it is not always possible to study the time trends. Also the limited scope and somewhat doubtful quality of the statistical records, in particular those relating to agriculture, impose obvious limitations. All that is attempted for the period 1901-1951, therefore, is a sweeping review of the interrelationships between demographic and agricultural variables with a view to providing a perspective for the study of change in the decades 1951-1961 and 1961-1971. The main conclusions are based on the analysis of data for the period 1951-1971.

The demographic data were obtained from the Census Reports of the two states and the records of vital statistics maintained by the Directorate of Health Services. The data on agriculture are available from the Crop and Season Reports of the Directorate of Agriculture in the respective states and from the Abstracts of Agricultural Statistics compiled by the Government of India. Some data were obtained directly from the official records of the ministries concerned.

The study begins with an outline of trends in population growth and an analysis of their components: birth rates, death rates and net migration rates. The trends in growth of agriculture and their components, changes in area, productivity (yield per hectare) and crop pattern are presented in chapter II. The analysis of interrelationships between growth of population and agriculture is completed in chapter III. An attempt is also made to observe the association between population change and pressure and to examine whether changes in agriculture provide a causal nexus between the two. The impact of population growth and movements on economic efficiency and welfare is analysed in chapter IV. The main highlights of the study are presented in the final chapter.

I. POPULATION CHANGE

A. PUNJAB

Punjab is a northwestern State of India, bordering Pakistan, with an area of 122,000 km^2 (47,106 sq mi). Punjab has a marked variety of landscape. In the north there are mountains whose altitude exceeds 1,800 metres. From the mountains and hills the land slopes gently southwestwards to the flat alluvial plains which form the major portion of Punjab. In the southern and southwestern parts of the plains there are extensive areas covered with sand dunes. The area adjoining Rajasthan State is, in fact, desert. Proximity to the hills and mountains in the north is the determining factor for the amount of rain received in the various parts of the State. The annual rainfall for the mountain region is more than 150 cm and that of the sub-montane region is 100 to 125 cm. The districts south of the sub-montane region receive about 75 cm, while the southern districts are dry and receive only 40 to 55 cm. However, Punjab has four major snow-fed perennial rivers-Jumna, Sutlej, Beas and Ravi - which have been major source for canal irrigation and the development of hydroelectricity. Cultivation has reached a high level in Punjab because a large proportion of the land is suitable for it. Provision of irrigation facilities has helped immensely in increasing the output.

1. Period covered

The present study covers the period 1901-1971. However, we have divided it into two segments; the pre-Partition period from 1901 to 1941 and the post-Partition period from 1951 to 1971. The decade 1941-1951 is omitted from consideration because, with the partition of the Punjab State, mass migration across what suddenly became international borders took place. Immediately following the partition, the administrative machinery was too ill-equipped and disorganized to keep any records even on the number of persons crossing borders. It is possible to obtain comparable figures for the period 1951-1971, even though the State of Punjab has undergone territorial changes at least twice since Partition in 1947.

2. Territorial coverage

Punjab was a major province of British India. At the time of the 1901 census, there were 32 British districts and some native states under the jurisdiction of the census superintendent. The Punjab province has undergone territorial changes from time to time. However, up to 1941, the changes were mostly minor and often due to the changes in the course of rivers.[1]

In the wake of Independence in 1947, the subcontinent was divided into India and Pakistan. The division on the western side was through the Punjab State which was partitioned, and out of its total of 29 districts, India received 12 complete districts. One tehsil of Gurdaspur district was amalgamated with Pakistan; the rest of the district was transferred to India. Some 186 villages of Lahore district were included in India and were mostly transferred to Amritsar district. In 1948, the eight princely states were amalgamated into the State of Punjab and East Punjab States Union (PEPSU).[2] In pursuance of the States Reorganization Act of 1956. PEPSU (after the eight princely states were integrated into five districts) and Punjab were merged. Thus, with the addition of five PEPSU districts, the number of districts in composite Punjab increased from 13 in 1951 to 18 in 1956. In 1960, Lahaul and Spiti, then a part of Kangra district was made into a full-fledged district, thus raising the number of districts to 19 at the time of the 1961 census.

Our study on population growth and agricultural change is confined to Indian Punjab as physically constituted in 1961. However, not all districts have been included in the discussion. For the five PEPSU districts, population data from the censuses are not available separately for the districts prior to 1951. In addition, these former princely states did not have good registration systems or data on the agricultural situation. Therefore, analysis for these five districts pertains only to the period 1951-1971. Simla and Lahaul and Spiti are largely hilly resort areas and, since agriculture plays a negligible role in their economy, they both have been omitted throughout the period under consideration. The population figures based on the earlier censuses have been adjusted for the district boundaries as of 1941, thus enabling comparability in the time trend and interdistrict analysis.

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[1] Between 1901 and 1941, a major territorial transfer occured soon after the 1901 census. The North-West Frontier Province was carved out of Punjab and formed a separate state. Again in 1917, when the capital of India was shifted from Calcutta to Delhi, Delhi district was remodelled by transferring parts of it to adjoining districts, and making Delhi into a separate province.

[2] Similarly, the 17 Punjab Hill States were combined to form Himachal Pradesh.

The state of Punjab was again bifurcated in 1966 into two separate states, Punjab and Haryana. The bifurcation was largely along the language line. Punjab, where the predominant language is Punjabi included in its territory 11 districts (Gurdaspur, Amritsar, Ferozepur, Ludhiana, Jullundur, Hoshiarpur, Ropar, Patiala, Sangrur, Bhatinda and Kapurthala). Except for Ropar, the other districts were the same as those which existed at the time of the 1961 census. Ropar is a new district carved out of Hoshiarpur and Ambala districts. In addition to these two new separate states formed from the composite Punjab State, the entire districts of Kangra, Simla, Lahaul and Spiti and some parts of Gurdaspur, Ambala and also Hoshiarpur districts were transferred to Himachal Pradesh. Further, Chandigarh, became a separate district and capital of both Haryana and Punjab. Originally it was part of Ambala district.

All these territorial changes would make comparative study rather difficult. Fortunately, the 1951 census population data are available at village level so that, with necessary adjustments, it is possible to obtain figures for the same territories. While our analysis is concerned with composite Punjab as it existed in 1961 (i.e. including both Haryana and Punjab), the territorial boundaries of the districts are those of the 1971 census. The figures for the 1961 and 1951 censuses are adjusted for the territorial limits of 1971.

3. Sources of data

The demographic data for Punjab come from the censuses. The first census of Punjab was taken in 1868, but it was incomplete and not all the areas were covered. But it set some precedents and the subsequent censuses improved in both quality and coverage.[3] The censuses provide basic information on age, sex and marital status distribution at district level. The censuses conducted during the British period also included information on the caste composition of the population. In addition to the census, there has been an attempt in India to gather vital statistics. In fact, as early as 1864, a uniform system was introduced for registering both births and deaths in British India. Although the system did not operate successfully in many parts of the country, there were areas where it was considered fairly good. In the British districts of Punjab, the vital statistics collected appear to be of reasonably good quality. In any event, the registration figures can be used for discerning some trends over time, and, when used in conjunction with the census figures, they do throw some light on the basic demographic situation in the region.

Data on agricultural trends in the country have been collected since the latter half of the nineteenth century and were assembled in *Statistical Abstract Relating to British India.* Most of the data on land utilization, output and productivity or yield were available at district level.[4] Thus, these have been the sources of information utilized in this report, keeping in mind the limitations of each set of data.

4. Size and growth of population: 1901-1971

After Partition, the area constituting Indian Punjab was reduced to less than half of the area of the former undivided Punjab. Consequently, the population of Indian Punjab was also reduced to about half the size. The undivided Punjab (consisting of British districts, Native States and Hill States) included in its jurisdiction nearly 35 million people at the 1941 census count, and about 16 million of these people were included in Indian Punjab (including Native States) carved out in 1948. As indicated earlier, the discussion for the period prior to Partition deals with only those British districts which later constituted Indian Punjab.[5]

As indicated in table 1, the population of undivided Punjab increased very slightly between 1901 and 1921: from 24.4 million to 25.1 million. The increase in population in British districts, which constituted nearly 32 per cent of the total population, was also very slight. The population of the 12 districts under consideration, however, declined from 10.5 million to 9.8 million during these two decades. This phenomenon is reflected in the proportion of population constituting Indian Punjab, which decreased from 43 to 39 per cent during 1901-1921.[6]

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[3] In the global perspective, India's population statistics, available from the censuses, "are above the average". See: Kingsley Davis, *The Population of India and Pakistan*, (Princeton, Princeton University Press, 1951), pp. 3-5.

[4] In pre-Independent India, the Department of Commercial Intelligence and Statistics was responsible for assembling and publishing the economic statistics. After Independence, the task of collecting data on agriculture was assigned to the Directorate of Economics and Statistics in the Ministry of Food and Agriculture and annual reports on estimates of area and production of crops at district level are published.

[5] The Native States which were amalgamated with Punjab after the States Reorganization Act of 1956 are not included in the discussion of pre-Partition period because detailed statistics for them are not available.

[6] Even if all the British districts of undivided Punjab are taken into account, the proportion of population residing in Indian Punjab decreased from 52.5 to 47.3 per cent during 1901-1921.

Table 1. Population of districts of Punjab, 1901-1941

(in thousands)

District	1901			1911			1921			1931			1941		
	Persons	Males	Females	Persons	Males	Females	Persons	Males	Females	Persons	Males	Females	Persons	males	Females
Hissar	781.6	418.1	363.5	804.9	438.5	366.4	816.8	435.6	381.2	899.5	485.7	413.8	1,006.7	536.7	470.0
Rohtak	834.1	443.7	390.4	714.8	385.4	329.4	772.3	417.4	354.9	805.6	432.8	372.8	956.4	500.1	456.3
Gurgaon	843.0	443.0	400.0	730.2	389.7	340.5	682.4	368.0	314.4	740.1	398.5	341.6	851.4	453.4	398.0
Karnal	884.7	479.8	404.9	801.2	438.5	362.7	828.8	453.7	375.1	852.6	469.9	382.7	994.6	542.9	451.7
Ambala	816.8	452.1	364.7	690.9	394.7	296.2	681.5	383.8	297.7	742.9	416.4	326.5	847.8	471.5	376.3
Kangra	768.1	399.1	369.0	770.4	401.1	369.3	766.1	393.6	372.5	801.3	415.3	386.0	899.4	470.3	429.1
Hoshiarpur	989.7	525.8	463.9	918.5	501.5	417.0	927.5	498.7	428.8	1,032.2	551.9	480.3	1,170.3	621.3	549.0
Jullundur	917.6	496.7	420.9	801.9	449.9	352.0	822.6	455.2	367.4	943.8	512.7	431.1	1,127.2	606.2	521.0
Ludhiana	673.1	369.2	303.9	517.2	293.5	223.7	567.6	318.8	248.8	672.5	375.6	296.9	818.6	446.9	371.7
Ferozepur	957.7	524.1	433.6	960.2	538.7	421.5	1,098.9	610.2	488.7	1,156.8	636.3	520.5	1,423.1	781.4	641.7
Amritsar	1,023.9	559.9	464.0	880.8	496.6	384.2	929.3	519.1	410.2	1,117.1	621.0	496.1	1,413.9	776.8	637.1
Gurdaspur	940.3	509.9	430.4	836.7	469.2	367.5	852.2	470.5	381.7	970.9	531.9	439.0	1,153.5	622.8	530.7
Total 12 districts	10,430.6	5,621.4	4,809.2	9,427.7	5,197.3	4,230.4	9,746.0	5,324.6	4,421.4	10,735.3	5,848.0	4,887.3	12,662.9	6,830.3	5,832.6
Total British districts of Punjab	19,942.7	10,734.5	9,208.2	19,579.0	10,771.0	8,808.1	20,685.5	11,306.5	9,379.0	23,580.9	12,880.5	10,700.3	28,418.8	15,383.6	13,035.2
Total Punjab (including princely and hill states)	24,367.1	13,144.3	11,222.8	23,791.8	13,093.9	10,697.9	25,101.5	13,732.3	11,369.2	28,490.9	15,561.2	12,929.7	34,309.9	18,581.3	15,728.5

Sources: (1) Census of India, 1931, vol. XVII, Punjab, part II, tables, (Lahore, "Civil and Military Gazette" Press 1933), pp. 6-7.

(2) Census of India, 1941, vol. VI, Punjab, tables, (Simla, Government of India Press, 1941, pp. 2-3.

Note: Figures are given for only British districts which constituted Indian Punjab. The princely states which were integrated in the State of Punjab after Independence are excluded.

In fact, this decline continued in 1931 and 1941. By 1941, Indian Punjab constituted 37 per cent of the population of undivided Punjab. It is quite likely that two groups of districts grew at different rates. The differentials could be the result of differentials in fertility and/or mortality levels and/or migration. [7] However, for purposes of this study, only the interdistrict variations in size and growth of population of Indian Punjab are considered.

The 12 districts of Punjab have been fairly homogeneous in size. According to the 1901 census, the population of Amritsar, the largest district, was 1.02 million, and that of Ludhiana, the smallest, was 0.67 million. Ludhiana, Kangra and Hissar districts had less than 0.8 million people but all the other districts had between 0.8 and 1.0 million people. However, by 1941, the variation between districts in population size had increased. During the 40-year period 1901-1941, all the districts had gained in population, but the growth was not uniform over space. The factors causing differentials in growth rates will be discussed at a later stage.

Table 2 shows that the 1901-1911 decade witnessed a net decrease in the population of Punjab State at an average annual rate of 1 per cent. This decrease was shared by all districts except Hissar, Kangra and Ferozepur. The population of the latter two districts remained more or less stationary, while that of Hissar increased at an average annual rate of 0.3 per cent. The decline in population in some districts, e.g. Ludhiana, Ambala, Rohtak and Amritsar, was more than 15 per cent. When the interdistrict differences in birth rates were presumably minimal due to absence of any widespread practice of contraception, the differences in growth rates can be explained by differential mortality and migration.

The negative growth rate and its magnitude reflect the deterioration in health conditions experienced by populations in different districts. Plague was virulent in Punjab for three consecutive years (1901, 1902 and 1903) and took a heavy toll of human life. It recurred in 1907. Cholera, smallpox and fever were also present. The agricultural situation was unfavourable and there were near-famine conditions for three years (1901-1903) in Gurgaon and Hissar districts. In addition to these calamities, an earthquake shook Kangra district in April 1905 and caused an estimated loss of 20,000 persons. These factors partly explain the decline in the population of Punjab during 1901-1911.

The next decade, 1911-1921, marks the beginning of an era of accelerated growth in population. Although the decrease of the previous decade was not completely wiped out, the population of the state increased at an average annual rate of 0.3 per cent. The growth rate was uneven between districts. Ferozepur district experienced a growth rate of nearly 11 per cent during the decade. Ludhiana and Rohtak showed significant recovery after suffering a great loss of human population during the 1901-1911 decade. However, even during the 1911-

Table 2. Average annual rate of growth of population of districts of Punjab, 1901-1941

(in percentages)

District	1901-1911			1911-1921			1921-1931			1931-1941			1901-1941		
	Persons	Males	Females	Persons	Males	Females	Persons	Males	Females	Persons	Males	Females	Persons	Males	Females
Hissar	0.29	0.48	0.08	0.15	-0.07	[illegible]	0.96	1.09	0.82	1.13	1.00	1.27	0.63	0.62	0.64
Rohtak	-1.54	-1.41	-1.70	0.77	0.78	0.75	0.42	0.36	0.49	1.72	1.45	2.02	0.34	0.30	0.39
Gurgaon	-1.44	-1.28	-1.61	-0.68	-0.57	-0.80	0.81	0.80	0.83	1.40	1.29	1.53	0.02	0.06	-0.01
Karnal	-0.99	-0.90	-1.10	0.34	0.34	0.34	0.28	0.35	0.20	1.54	1.44	1.67	0.29	0.31	0.27
Ambala	-1.67	-1.36	-2.08	-0.06	-0.28	0.05	0.86	0.82	0.92	1.32	1.24	1.42	0.09	0.10	0.08
Kangra	0.03	0.05	0.01	-0.06	-0.19	0.09	0.45	0.54	0.36	1.16	1.24	1.06	0.39	0.41	0.38
Hoshiarpur	-0.75	-0.46	-1.07	0.10	-0.06	0.28	1.07	1.01	1.13	1.26	1.18	1.34	0.42	0.42	0.42
Jullundur	-1.35	-0.99	-1.79	0.25	0.12	0.43	1.37	1.19	1.60	1.78	1.68	1.89	0.51	0.50	0.53
Ludhiana	-2.63	-2.29	-3.06	0.93	0.83	1.06	1.70	1.64	1.77	1.97	1.74	2.25	0.49	0.48	0.50
Ferozepur	0.03	0.27	-0.28	1.08	1.25	1.48	0.51	0.42	0.63	2.07	2.05	2.09	0.99	1.00	0.98
Amritsar	-1.51	-1.20	-1.89	0.54	0.44	0.65	1.84	1.79	1.90	2.36	2.24	2.50	0.81	0.82	0.79
Gurdaspur	-1.18	-0.83	-1.58	0.18	0.03	0.38	1.30	1.23	1.40	1.72	1.58	1.90	0.51	0.50	0.52
Total	-1.01	-0.78	-1.28	0.33	0.25	0.43	0.97	0.92	1.01	1.65	1.55	1.77	0.48	0.49	0.48

Source: Based on table 1.

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[7] It can also be hypothesized that enumeration in districts which are now in Pakistan progressively improved with each census. Conversely, the enumeration in the districts constituting Indian Punjab progressively deteriorated with each census. Either or both of these possibilities would affect the growth rates.

1921 decade, there were districts which continued to show decrease in their populations; Gurgaon and, to a lesser extent, Ambala and Kangra suffered losses. There was an outbreak of plague in Punjab in 1915 but generally the conditions were more favourable than elsewhere in India. The Indian subcontinent in general and western India in particular were swept with two successive waves of a fatal influenza epidemic during 1918-1920. Although Punjab by and large escaped from the severity of the epidemic, the population of Gurgaon, the southernmost district and adjacent to the influenza belt, suffered some loss of life. The decline in its population during 1911-1921 was partly caused by the influenza epidemic.

During 1921-1931, conditions were, on the whole, quite favourable to growth in Punjab, and the average intercensal increase of nearly 10 per cent was shared by most of the districts. The rapidly industrializing districts of Ludhiana and Amritsar witnessed even higher growth rates of 17 and 18 per cent, respectively, during the decade. The growth rate of Rohtak, Ferozepur and Kangra, on the other hand, was significantly lower than the state average; it was only around 5 per cent during the entire decade. In Rohtak and Ferozepur, malarial fever was partly responsible for some loss of life.

The decade 1931-1941 witnessed a rapid extension in medical services. This development is reflected in the decline in the death rate. There were occurrences of malarial fever and famine conditions, especially in Gurgaon and Rohtak, but the over-all impact of these calamities on population growth was small. In fact, the average intercensal growth rate of the state was nearly 17 per cent, which was unprecedented in the history of Punjab. All the 12 districts of the state experienced a growth rate of more than 10 per cent. Districts like Ludhiana, Ferozepur and Amritsar witnessed an even greater increase of the order of nearly 20 per cent. In these districts, industries were being started fast, and that way probably bringing in migrants from the neighbouring districts.

Looking at the period 1901-1941 as a whole, the average annual rate of growth of Punjab worked out at less than one half per cent. The growth rate was higher than the state average in Ferozepur, Amritsar, Gurdaspur, Hissar and Jullundur. The first four districts are located along the border with Pakistan and Rajasthan. Of course, during 1901-1941 this border with Pakistan was not demarcated and districts on either side of what became the international boundary were part of Punjab State. In the past, Ferozepur was an agriculturally prosperous area and escaped from the epidemics which were responsible for the decline in population in some other districts. Amritsar, before Partition, was located in the heart of the province. It flourished partly because canals irrigated about three fourths of the sown area. In addition to agriculture, trade and industry also developed in Amritsar. Along the road from Amritsar to Gurdaspur, small-scale industries have developed. High density of population and relatively small cultivated area *per capita* have been partly responsible for diversification of employment. Therefore, economically, the belt from Gurdaspur to Amritsar had developed in the past. Hissar, on the other hand, is a predominantly agricultural district with low population density. However, because of the spread of canal irrigation in this region with scanty rainfall, the growth of population has been high. There might have been some in-migration also from the more densely populated districts of the state.

The discussion of variations in interdistrict growth rates is based on intercensal rates of growth of population during 1901-1941. The next section deals with the population size and growth of districts of composite Punjab[8] during 1951-1971. In addition to the districts discussed above, the analysis is extended to five more districts which were princely states prior to independence. Kangra district, however, is omitted, partly because it was transferred to Himachal Pradesh and has undergone major boundary changes. The territorial boundaries of the districts are those which existed at the time of the 1971 census, and the population figures for 1951 and 1961 are adjusted to these boundary limits.[9]

During the bifurcation of Punjab into Punjab and Haryana, the total number of districts was increased to 18. In addition, Chandigarh, which was retained as the capital of both the states and which became union territory, constituted a separate district. Thus the analysis of population for 1951-1971 pertains to 19 districts whose boundaries are quite different from what they were prior to 1951.

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[8] By composite Punjab is meant the districts under the jurisdiction of Punjab at the time of the 1961 census. In other words, it consists of the Haryana and Punjab States constituted in 1966.

[9] Starting with the 1951 census, population data are available at village level in the district census handbooks. It is therefore relatively easy to adjust population figures.

Table 3 gives the population figures and table 4 gives the growth rates for the districts of Punjab and Haryana for the years 1951-1971. The population of Punjab as a whole (including districts which comprised Haryana State), grew at about an average annual rate of 2.4 per cent during both the 1951-1961 and the 1961-1971 periods.[10] The rate of growth in Punjab in 1951-1961 was slightly higher than the all-India rate. However, in 1961-1971, the two were more or less the same. Within Punjab there was a considerable range in population growth: in 1951-1961 it varied from 0.9 per cent in Hoshiarpur to nearly 3.9 in Hissar and 3.2 per cent in Karnal and Patiala districts. In 1961-1971, the slow-growing districts, such as Amritsar, Jullundur and Hoshiarpur, continued to grow at a relatively low rate. Similarly, Karnal, Hissar, Jind and Gurgaon experienced a high growth rate during both the decades. It is interesting to note that, on the whole, districts which comprised Haryana State experienced higher growth rates than those districts which comprised the newly constituted Punjab State. Patiala district in Punjab was the major exception: it experienced high growth in population. After Partition, the pattern of growth appears to have changed considerably. The relatively fast-growing districts have slowed down, whereas those which experienced setbacks from time to time in past have picked up momentum and witnessed significant increases in their populations. The major checks on population growth in the past were epidemics and famines. These ravages of human population, even if not brought under control completely, no longer decimate the population as they did in past. The advances in medical technology, pest control and availability of inexpensive sulfa drugs and antibiotics coupled with public health and sanitary measures have lowered the mortality level.

5. Population growth in rural areas

The effects of growing population pressure on crop pattern or utilization of labour force on land can be better understood in the context of trends in growth of rural population. However, the rural-urban breakdown of district or state populations is available for the current census only and not for the earlier census adjusted to the boundary changes. This makes it impossible to calculate the rural growth rates with proper adjustment for boundary changes. However, as indicated in table 5, urban population forms a small proportion of the total population (about 12 per cent during 1901-1921), so that the total and rural growth rates differ very little, if at all.

A significant increase in urban population occurred only after 1941. In the wake of Partition, the movement of population from what became Pakistan was largely to urban areas in Indian Punjab. The exodus of population from Indian Punjab, on the other hand, was from rural areas. This migratory movement led to a rapid increase in urban population in Indian Punjab and the urban proportion increased from about 16 per cent in 1941 to nearly 20 per cent in 1951. The proportion of population living in urban areas slowly increased between 1951 and 1971; according to the 1971 census it stood at about 22 per cent.[11] This indicates that the growth rate of the urban population is higher than that of the total population or rural population. For rural areas, the actual growth rates would be somewhat lower than those for the total population, but the difference would be only marginal in most cases.

6. Components of population change

The preceding section has dealt with changes in the population of Punjab over time. The measurement of population change was made through the comparison of growth rates derived from successive censuses. In this section, the components of population change -- births, deaths, migration are examined.

The direct measures of components of population change are vital statistics, and Punjab has had a fairly good registration system.[12] The plausibility of the recorded statistics for the period 1901-1941 and 1951-1971 is determined with the help of some techniques of measurement of fertility and mortality levels from incomplete demographic data.

The vital rates for the population of various districts of Punjab are presented in table 6. The decade 1901-1911 was a period of severe calamities in the form of famines and epidemics and these were responsible for high death rates in almost all

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[10] The two reorganized states taken as two separate units recorded a big difference in their growth rates. During the 1961-1971 decade, Haryana and Punjab experienced increases of 31 and 21 per cent respectively.

[11] If one looks at the data for urban population separately for Punjab and Haryana, a significant difference in the process of their urbanization becomes evident. The state of Haryana is less urban than Punjab; moreover, urbanization in Haryana has not increased as fast as in Punjab.

[12] The registration agency in rural areas was the police, who were subjected to close supervision by administrators at higher levels.

Table 3. Population of districts of composite Punjab, 1951-1971

(in thousands)

District a/	1951			1961			1971		
	Persons	Males	Females	Persons	Males	Females	Persons	Males	Females
Ambala	678.2	373.4	304.8	885.8	485.1	400.7	1,098.4	590.8	507.6
Karnal	1,077.4	579.8	497.6	1,490.4	804.8	685.7	1,981.3	1,068.6	912.7
Rohtak	1,122.0	592.6	529.4	1,420.4	751.2	669.2	1,785.5	948.9	836.6
Gurgaon	967.7	512.9	454.8	1,240.7	659.4	581.3	1,707.4	917.8	789.6
Mahendragarh	439.2	226.5	212.7	543.4	281.6	261.8	691.7	364.0	327.7
Hissar	1,049.5	562.9	486.6	1,544.9	830.0	714.9	2,133.0	1,143.2	989.8
Jind	339.6	183.5	156.1	464.9	250.7	214.2	639.6	344.1	295.5
Gurdaspur	851.0	460.9	390.1	980.9	524.8	456.1	1,229.3	650.3	579.0
Amritsar	1,366.5	742.1	624.4	1,534.2	827.4	706.8	1,835.5	988.9	846.6
Ferozepur	1,271.1	687.1	584.0	1,613.1	873.1	740.0	1,905.8	1,019.1	886.7
Ludhiana	878.9	476.2	402.7	1,107.0	597.1	509.9	1,419.5	768.8	650.7
Jullundur	1,054.1	566.2	487.9	1,226.2	654.8	571.4	1,454.5	772.4	682.1
Kapurthala	295.1	156.9	138.2	343.8	182.3	161.5	429.5	227.3	202.2
Hoshiarpur	794.9	423.6	371.3	871.2	457.8	413.4	1,052.1	553.9	498.2
Ropar	377.9	208.4	169.5	471.6	260.2	211.4	545.0	294.0	251.0
Patiala	702.3	389.3	313.0	960.2	525.2	435.0	1,215.1	657.9	557.2
Sangrur	767.0	421.3	345.7	954.3	520.8	433.5	1,146.7	623.1	523.6
Bhatinda	801.7	436.1	365.6	1,072.8	584.2	488.6	1,318.1	710.7	607.4
Chandigarh b/	-	-	-	119.9	-	-	257.3	147.1	110.2
Total	14,834.1	7,999.7	6,834.4	18,845.8	10,070.5	8,655.4	23,845.3	12,790.9	11,054.4

Sources: (1) Census of India, 1971, Series 6 - ***Haryana***, Part II-A, *General Population Tables*, (New Delhi, Government of India Press, 1973), pp. 37-39.
(2) Census of India, 1971, Series 17 - ***Punjab***, Part II-A, *General Population Tables*, (Chandigarh, Controller, Printing and Stationery), pp. 71-74.
(3) Census of India, 1971, Series 25 - ***Chandigarh, District Census Handbook***, (Chandigarh, Controller of Printing and Stationery), 1973, p. 28.

Note: Composite Punjab refers to Punjab State as it existed prior to its bifurcation in 1966.
a/ After 1966, the first 7 districts constitute Haryana State and the remaining 11 districts (excluding Chandigarh) constitute the new Punjab State.
b/ Chandigarh became a district and Union Territory during the 1966 bifurcation. Population figures for Chandigarh do not exist prior to 1961.

Table 4. Average annual rate of growth of districts of composite Punjab, 1951-1971

(in percentages)

District	1951-1961			1961-1971			1951-1971		
	Persons	Males	Females	Persons	Males	Females	Persons	Males	Females
Ambala	2.67	2.62	2.73	2.15	1.97	2.36	2.41	2.29	2.55
Karnal	3.25	3.28	3.21	2.85	2.84	2.86	3.05	3.06	3.03
Rohtak	2.36	2.37	2.34	2.29	2.34	2.23	2.32	2.35	2.29
Gurgaon	2.49	2.51	2.45	3.19	3.31	3.00	2.84	2.91	2.76
Mahendragarh	2.13	2.18	2.08	2.41	2.57	2.25	2.27	2.37	2.16
Hissar	3.87	3.88	3.85	3.23	3.20	3.25	3.55	3.54	3.55
Jind	3.14	3.12	3.16	3.19	3.17	3.22	3.16	3.14	3.19
Gurdaspur	1.42	1.30	1.56	2.26	2.14	2.38	1.84	1.72	1.97
Amritsar	1.16	1.09	1.24	1.79	1.78	1.80	1.48	1.44	1.52
Ferozepur	2.38	2.39	2.37	1.67	1.55	1.81	2.02	1.97	2.09
Ludhiana	2.31	2.26	2.36	2.49	2.53	2.44	2.40	2.39	2.40
Jullundur	1.51	1.45	1.58	1.71	1.65	1.77	1.61	1.55	1.68
Kapurthala	1.53	1.50	1.56	2.23	2.21	2.25	1.88	1.85	1.90
Hoshiarpur	0.92	0.78	1.07	1.89	1.91	1.87	1.40	1.34	1.47
Ropar	2.22	2.22	2.21	1.45	1.22	1.72	1.83	1.72	1.96
Patiala	3.19	2.99	3.29	2.35	2.25	2.47	2.74	2.62	2.88
Sangrur	2.19	2.12	2.26	1.84	1.79	1.89	2.01	1.96	2.08
Bhatinda	2.91	2.92	2.90	2.06	1.96	2.18	2.49	2.44	2.54
Chandigarh	-	-	-	7.64	-	-	-	-	-
Total	2.39	2.30	2.36	2.35	2.39	2.45	2.37	2.35	2.40

Source: Based on table 3.

Table 5. Proportion of urban population in the states of Punjab and Haryana, 1901-1971

Census year	Punjab as of 1971			Haryana as of 1971			Punjab and Haryana together		
	Total population	Urban population	Percentage urban	Total population	Urban population	Percentage urban	Total population	Urban population	Percentage urban
1901	7,544,790	934,766	12.4	4,623,079	574,074	12.4	12,167,869	1,508,840	12.4
1911	6,731,510	813,224	12.1	4,174,690	449,704	10.8	10,906,200	1,262,928	11.6
1921	7,152,811	869,526	12.2	4,255,905	481,195	11.3	11,408,716	1,350,721	11.8
1931	8,012,325	1,168,413	14.6	4,559,931	564,743	12.4	12,572,256	1,733,156	13.8
1941	9,600,236	1,657,414	17.3	5,272,845	705,945	13.4	14,873,081	2,363,359	15.9
1951	9,160,500	1,989,267	21.7	5,673,714	968,494	17.1	14,834,114	2,957,761	19.9
1961 a/	11,135,069	2,567,306	23.0	7,590,543	1,307,680	17.2	18,845,493	3,974,248	21.1
1971 a/	13,551,060	3,216,179	23.7	10,036,808	1,772,959	17.7	23,845,119	5,222,078	21.9

Sources: (1) Census of India, 1971, Series 17 - *Punjab*, Part II-A
General Population Tables, pp. 71,111.
(2) Census of India, 1971, Series 6 - *Haryana*, Part II-A,
General Population Tables, pp. 37, 59.

a/ The total of Punjab and Haryana, including the population of Chandigarh.

Table 6. Birth and death rates based on registration data, rates of natural increase and over-all growth rates and net migration rates for districts of Punjab, 1901-1950

(per thousand)

District	1901-1910				
	Birth rate	Death rate	Natural increase rate	Growth rate	Net migration rate
Hissar	42.7	41.4	1.3	2.9	1.6
Rohtak	38.2	48.4	-10.2	-15.4	-5.2
Gurgaon	40.6	49.9	-9.3	-14.4	-5.1
Karnal	39.6	47.7	-8.1	-9.9	-1.8
Ambala	32.4	46.9	-14.5	-16.7	-2.2
Kangra	35.3	34.0	1.3	0.3	-1.0
Hoshiarpur	38.9	42.6	-3.7	-7.5	-3.8
Jullundur	38.5	47.0	-8.5	-13.5	-5.0
Ludhiana	36.8	56.5	-19.7	-26.3	-6.6
Ferozepur	41.9	45.9	-4.0	0.3	4.3
Amritsar	42.2	51.9	-9.7	-15.1	-5.4
Gurdaspur	42.4	49.2	-6.8	-11.8	-5.0
Total	40.8	43.5	-2.7	-10.1	-7.4

District	1911-1920				
	Birth rate	Death rate	Natural increase rate	Growth rate	Net migration rate
Hissar	46.5	36.3	10.2	6.0	-4.2
Rohtak	53.2	44.3	8.9	7.5	-1.4
Gurgaon	50.3	53.4	3.1	7.1	4.0
Karnal	47.7	43.4	4.3	3.4	-0.9
Ambala	39.5	37.8	1.7	-1.6	-3.3
Kangra	36.4	33.5	2.9	-0.6	-3.5
Hoshiarpur	41.0	34.2	6.8	1.0	-5.8
Jullundur	43.3	35.6	7.7	2.6	-5.1
Ludhiana	45.6	37.7	7.9	9.4	1.5
Ferozepur	43.7	32.2	11.5	13.3	1.8
Amritsar	47.7	40.1	7.6	5.4	-2.2
Gurdaspur	45.9	38.4	7.5	2.1	-5.4
Total	44.9	38.5	6.4	3.3	-2.9

(Cont'd)

Table 6 (Cont'd)

(per thousand)

District	1921-1930				
	Birth rate	Death rate	Natural increase rate	Growth rate	Net migration rate
Hissar	40.8	30.0	10.8	9.5	-1.3
Rohtak	42.7	36.6	6.1	4.4	-1.7
Gurgaon	45.1	35.6	9.5	8.9	-0.6
Karnal	38.6	37.8	0.8	2.8	2.0
Ambala	37.1	29.7	7.4	8.7	1.3
Kangra	35.3	32.0	3.3	4.5	1.2
Hoshiarpur	41.2	28.3	12.9	10.7	-2.2
Jullundur	42.2	25.4	16.8	13.8	-3.0
Ludhiana	41.5	27.3	14.2	17.1	2.9
Ferozepur	37.4	26.0	11.4	5.1	-6.3
Amritsar	43.5	30.8	12.7	18.4	5.7
Gurdaspur	43.9	30.3	13.6	12.4	-1.2
Total	40.8	30.6	10.2	10.1	-0.1

District	1931-1940				
	Birth rate	Death rate	Natural increase rate	Growth rate	Net migration rate
Hissar	41.9	28.1	13.8	11.3	-2.5
Rohtak	45.9	25.6	20.3	16.9	-3.4
Gurgaon	46.9	29.8	17.1	14.0	-3.1
Karnal	44.2	30.0	14.2	15.5	1.3
Ambala	42.5	28.8	13.7	13.2	-0.5
Kangra	36.0	27.1	8.9	11.7	2.8
Hoshiarpur	41.7	26.6	15.1	12.6	-2.5
Jullundur	42.8	22.4	20.4	17.7	-2.7
Ludhiana	42.3	24.6	17.7	19.9	2.2
Ferozepur	42.4	24.5	17.9	20.7	2.8
Amritsar	43.6	24.9	18.7	22.4	3.7
Gurdaspur	46.7	26.2	20.5	17.5	-3.0
Total	43.1	26.4	16.7	16.5	-0.2

(Cont'd)

Table 6 (Cont'd)

(per thousand)

District	1941-1950				
	Birth rate	Death rate	Netural increase rate	Growth rate	Net migration rate
Hissar	40.1	25.7	14.4	3.4	-11.0
Rohtak	41.6	23.0	18.6	12.8	-5.8
Gurgaon	40.2	25.4	14.8	9.6	-5.2
Karnal	40.0	25.4	14.6	9.6	-5.0
Ambala	38.1	24.4	13.7	7.2	-6.5
Kangra	34.0	24.4	9.6	4.0	-5.6
Hoshiarpur	41.2	25.0	16.2	-7.7	-23.9
Jullundur	39.2	21.2	18.0	-6.7	-24.7
Ludhiana	39.4	20.5	18.9	0.8	-18.1
Ferozepur	40.2	23.8	16.4	-7.6	-24.0
Amritsar	42.8	24.9	17.9	-17.0	-34.9
Gurdaspur	36.7	21.1	15.6	-1.3	-16.9
Total	39.6	23.8	15.8	-	-

Source: The registration data and rates are available in the **Public** Health Reports of Punjab and reproduced in the Census publications. For birth and death rates for the periods 1901-1910 and 1911-1920, for example, see:

(1) Census of India, 1911, vol. XIV, ***Punjab***, part I, ***Report*** (Lahore, "Civil and Military Gazette" Press, 1912), p. 68.

(2) Census of India, 1912, vol. XV, ***Punjab and Delhi***, part I, ***Report***, (Lahore, "Civil and Military Gazette" Press, 1923), pp. 98-99.

Note: The estimates for Punjab as a whole pertain to all the British districts of Punjab province.

the districts of Punjab. For the state as a whole, the rate of natural increase was lower than the growth rate, thereby indicating that there was net out-migration from the state.[13] It is possible that, during times of epidemics like plague, people migrate to the adjoining areas which are not affected and return to their usual place of residence after some time. The decline in population in districts of Ludhiana, Ambala, Amritsar and Gurgaon was more than 9 per 1,000. All the other districts, except Hissar and Kangra, recorded a decline in their population.

In 1911-1920 the rate of natural increase was very near the over-all growth rate. Only in Hissar, Hoshiarpur, Jullundur and Gurdaspur, the rate of natural increase was appreciably higher than the growth rate, thereby indicating a fairly heavy out-migration from these districts. Ambala and Kangra continued to report low birth and death rates compared with other districts, presumably due to deficiencies in the registration system in these districts. In 1921-1930, there was only a slight decline in the birth rates in various districts, but there was an appreciable decline in the death rates. This resulted in higher growth rates in most of the districts. The rate of natural increase was very near the growth rate in most of the districts. The exceptions were Ferozepur and Amritsar. The former experienced net out-migration and the latter net in-migration.

In 1931-1940, there was little change in the district birth rates and again a perceptible decline in the death rates. The widening gap between birth and death rates explains the moderately high growth rates of the districts. The rate of natural increase in each district was very near the over-all growth rate, indicating that migration played a very small role in population growth. The next decade of 1941-1950 was a very unusual period in the history of Punjab. Registration efficiency might have been adversely affected by Partition and its aftermath, but there was no indication of any substantial breakdown. The registered district birth and death rates were only slightly lower than those for 1931-1940 and the district rates of natural increase in the two decades were very close. However, there was mass migration between the districts of the two countries and, in the absence of any systematic records of this movement over a short period, it is difficult to analyse the data for the decade of 1941-1951.

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[13] During large-scale famines or epidemics, the administrative machinery recording vital events tended to break down and such temporary dislocation might explain the relatively low birth rate recorded in some districts. Since rates of net migration are obtained by differencing the rates of natural increase (difference between birth and death rates) and intercensal rates of growth, the figures would be biased to that extent.

7. Vital rates: 1951-1971

The vital rates based on the registration system for the districts of Punjab for the period 1951-1960 are given in table 7. It appears that the registration system of PEPSU districts (consisting of former princely states), which were amalgamated into the State of Punjab, was rather incomplete or inefficient. As princely states, they had lacked the tradition of recording vital statistics. In the other districts of the Punjab, the system of registration appears to have been reasonably efficient.

For the period 1961-1971, the registered vital statistics in the Punjab (including both States of new Punjab and Haryana) could not be relied upon. The recorded birth rates indicated a crude birth rate of about 20 per 1,000 population and the registered death rates were as low as 7 to 10. It has been decided, therefore, to omit the registration data for this decade and rely on the estimated rates. The procedure of estimation is outlined in annex I.

The birth rates for 1951-1961 and 1961-1971 were estimated by reverse survival method. As indicated in table 8, the difference between the registered rates and the estimated rates in the former British districts for 1951-1961 was negligible in most cases. The only exception was Hissar, where the registered birth rate was significantly lower than the estimated rate. Comparison for 1961-1971 of estimated rates with registered rates was not possible because of non-availability of the latter.

The following main conclusions emerge from the analysis of the demographic data for Punjab during 1951-1961 which are presented in table 7.

(1) During the decade, Punjab had a high birth rate of about 44 and a moderate death rate of 18, leading to a fairly high rate of natural increase. It was moderated only slightly by a small net decade out-migration loss of 2.3 per thousand.

(2) Birth and death rate differentials among districts were small. Districts which now form part of Haryana State, namely Hissar, Gurgaon, Karnal and Ambala, had a slightly higher birth rate--around 45. However, with the exception of Hissar, the death rate was within a narrow range of 15-20.

(3) The major factor contributing to variations in the 1951-1961 decade growth rate of districts appears to be migration. Hissar experienced substantial net in-migration, whereas Hoshiarpur, Jullundur, Amritsar and Gurdaspur experienced substantial net out-migration. They have been out-migrating districts in the past also. Other districts had small net out-migration, except for Karnal and Ambala which experienced a small net in-migration.

The estimates of birth rates for the decade 1961-1971 are rather tentative and no firm conclusions can be drawn regarding changes between 1961 and 1971 in view of the methodological limitations of the estimates. However, the estimated rates indicate that the birth rates in the districts of what now constitutes Haryana were higher than those in Punjab with the sole exception of Ambala. In new Punjab, the birth rates were around 40 and showed still lower levels in a few districts. There is a small but perceptible decline in the birth rates of districts of Punjab between 1951-1961 and 1961-1971, whereas in the case of districts of Haryana the trend is essentially the same.

Given the limitations of the 1961-1971 estimates, a comparison was also made of the child-woman ratios for the districts of Punjab. These ratios are directly obtained from the censuses of 1961 and 1971. 14/ The limitations of the ratio of children to women as a measure of fertility are many and well known. However, in the absence of any other measure, it proves useful for a study of interregion comparisons and also time trends in fertility. Since the data for children 0-4 are not yet available from the 1971 census, the data on children 0-14 years is used in the numerator. The child-woman ratios given in table 9 do suggest a possibility of a decline in fertility in Jullundur, Ludhiana, Amritsar, Bhatinda, Kapurthala and Patiala (and this conclusion would be *a fortiori* if adjustment was made for improvement in the survival rates of children between 1961 and 1971). In the case of districts of Haryana, on the other hand, child-woman ratios increased between 1961 and 1971. Given the weakness of the ratio as a measure of fertility, this increase cannot be interpreted as an increase in fertility level only. It may also be pointed out that the ordering of districts in respect of birth rates and child-woman ratios is nearly the same so that either measure could be used to give the relative position of different districts.

14/ Child-woman ratio is the ratio of children under 5 years of age to women of childbearing age, generally taken as 15 to 49.

Table 7. Birth and death rates based on registration data and rates of natural increase and over-all growth rates and net migration rates for the districts of Punjab, 1951-1960

District	Birth rate	Death rate	Natural increase rate	Growth rate	Net migration rate
Hissar	38.6	22.8	15.8	38.7	22.9
Rohtak	44.5	15.3	29.2	23.6	-5.6
Gurgaon	46.5	18.6	27.9	24.9	-3.0
Karnal	42.9	15.1	27.8	32.5	4.7
Ambala	43.1	16.3	26.8	26.7	-0.1
Hoshiarpur	43.4	20.2	23.2	9.2	-14.0
Jullundur	41.6	17.5	24.1	15.1	-9.0
Ludhiana	38.8	15.2	23.6	23.1	-0.5
Ferozepur	42.0	15.0	27.0	23.8	-3.2
Amritsar	42.2	15.2	27.0	11.6	-15.4
Gurdaspur	41.6	16.0	25.6	14.2	-11.4
Patiala	25.8	11.7	13.1	31.9	18.8
Sangrur	26.6	9.0	17.9	21.9	4.0
Bhatinda	28.5	9.2	19.3	29.1	9.8
Kapurthala	30.9	10.3	20.6	15.3	-5.3
Mahendragarh	38.4	13.4	25.0	21.3	-3.7
Total	41.7	15.9	25.8	23.5	-2.3

Source: Based on the Public Health Reports of Punjab.

Note: The rural areas of the first 12 districts registered a birth rate of 41.8 and a death rate of 16.1 during 1951-1960.

Table 8. Birth rates registered and estimated by reverse survival method for districts of Punjab, 1951-1960, and estimated for 1961-1970

District	1951-1960		1961-1970 [a]
	Registered birth rate	Estimated by reverse survival	Estimated by reverse survival
Hissar	38.6	47.5	44.2
Rohtak	44.5	44.0	44.8
Gurgaon	46.5	44.3	46.6
Karnal	42.9	45.9	47.0
Ambala	43.1	40.8	40.3
Kangra	37.6	38.8	
Hoshiarpur	43.4	36.5	40.4
Jullundur	41.4	37.2	36.9
Ludhiana	38.8	38.3	38.3
Ferozepur	42.0	41.9	40.8
Amritsar	42.2	38.6	37.8
Gurdaspur	41.6	40.3	41.8
Bhatinda	28.5	42.0	37.5
Kapurthala	30.9	39.7	40.2
Mahendragrah	38.4	44.0	45.0
Patiala	25.8	42.7	40.8
Sangrur	26.6	41.6	42.0
Total	43.6	—	39.5

[a] The registered birth rates for this decade were grossly understated and could not be relied upon.

Since interdistrict variations in registered death rates were observed to be erratic, a uniform death rate of 14.2 as estimated at the state level was assumed to hold true for all districts, and, by subtracting it from birth rates, the rates of natural increase were obtained. The difference between rates of natural increase and growth rates is shown as net migration rates. If there is an over-estimation bias in birth rates and hence in natural increase, out-migration is also over-estimated and in-migration underestimated. The net migration rates given in table 7, however, indicate the *relative* movements of population in different districts, but not their precise magnitudes.

Table 9. Ratio of children 0-14 to women 15-49 in the districts in Punjab, 1961 and 1971

District	1961	1971
Hissar	2.08	2.44
Rohtak	2.15	2.42
Gurgaon	2.06	2.28
Karnal	2.19	2.30
Ambala	1.99	1.98
Hoshiarpur	1.88	1.89
Jullundur	1.90	1.86
Ludhiana	1.91	1.78
Ferozepur	2.07	2.07
Amritsar	2.03	1.82
Gurdaspur	2.04	2.06
Bhatinda	2.06	1.94
Kapurthala	2.04	1.97
Mahendragarh	2.18	2.33
Patiala	2.12	2.01
Sangrur	2.10	2.10
Total	-	-

Sources: (1) Census of India, 1961, vol. XIII, *Punjab*, part II. A, *General Population Tables*
(2) Census of India, 1971, based on one per cent sample tables.

8. Migration

In addition to births and deaths, migration is one of the basic factors affecting change in the population of an area. It is usually the primary factor in population redistribution among geographic areas. Internal migration is often from rural to urban areas, signifying industrialization. It can also be from one rural area to another, especially when new lands are made available for agriculture by providing irrigation or drainage facilities. However, internal mobility is rather difficult to measure and therefore estimates of net or gross movement are not always available. Indirect methods of measurement are often, introduced to study migration and its trends.

Indian censuses have included a question on place of birth to be answered by every individual enumerated. If the place of birth is different from the village or town of enumeration, he or she is taken as a migrant. It is in this sense that the term "migrant" is used in this discussion. Figures of migration thus obtained by the census actually give life-time migration. The census reports show the number of persons enumerated in the district but born outside the village or town of enumeration, separately for cases where the birth place is (a) within the district of enumeration, (b) within the state of enumeration but outside the district of enumeration, (c) outside the State of enumeration but within India and (d) outside India. The Census tables show the number of in-migrants to the state and out-migrants from the state to other states in India, and those who may have gone out of the country. At the district level, figures of in-migrants are available but not those of out-migrants. Thus, it is possible to deduce the number of life-time in-migrants to a district if persons born within the district of enumeration are excluded; and,

Table 10. Estimates of in-migrants to and out-migrants from Punjab State, 1951 and 1961

	Year	Persons	Males	Females
Life-time in-migrants to Punjab	1961	2,880,423	1,483,301	1,397,122
	1951	2,804,390	1,463,230	1,341,160
Life-time in-migrants from Pakistan to Punjab	1961	2,115,955	1,136,877	979,078
	1951	2,731,929	1,461,442	1,270,487
Life-time in-migrants excluding Pakistan to Punjab	1961	764,468	346,424	418,044
	1951	72,461	1,788	70,673
Life-time out-migrants from Punjab to other states in India	1961	1,318,813	685,401	633,412
	1951	676,974	366,023	310,951

Sources: (1) Census of India, Paper No. 4 of 1954, *Displaced Persons – 1951 Census*, (New Delhi, Government of India Press, 1954), p. 42.

(2) Census of India, 1961, vol. XIII, *Punjab*, part I-A (i), *General Report*, (Simla, Government of India, 1969), pp. 245-247.

at the state level, if those born within the state of enumeration are excluded. By taking the difference between the life-time migrant figures for the 1961 and the 1951 Censuses, it is possible to get the migration gain in 1961 over that in 1951.

Migrants enumerated in 1961 consist of the survivors of the migrants as of 1951 and the survivors of fresh migrants during 1951-1961. The term "survivors" means the number left after depletion due to death or exit by out-migration. Migration gain is thus the excess on the 1961 census date of survivors of fresh migrants in the decade over the loss of 1951 migrants. It has its known limitations, however, and the peculiar Indian practice of contracting the marriage of daughters outside the village or town of residence and also of going back to the parents' home for child delivery imposes additional limitations. If marriage outside the village or town of residence involves crossing the state boundary, it adds substantially to migration figures but has little economic significance. The practice of going back to the parental home for confinement gives rise to spurious migration.

Life-time migrants for Punjab as shown by the 1951 and 1961 censuses are given in table 10.[15] According to this, in 1961 the persons born in other states and countries formed nearly 15 per cent of the total population, which is quite substantial. However, it must be remembered that Punjab has a large number of Punjabis who were born in areas now in Pakistan and came to India in the wake of Partition. In 1951, the number of such displaced persons in Punjab and the PEPSU districts was 2.73 million.[16] In 1961 they numbered 2.12 million.[17] Thus, they made up the bulk of the in-migrants to Punjab. Their number was reduced slightly between 1951 and 1961, partly because of the loss from deaths among Pakistan-born persons enumerated in Punjab in 1951. Also, some of them might have migrated to other states during 1951-1961. There was probably also some gain during 1951-1961 on account of some migration from Pakistan after 1951. The latter was perhaps small in magnitude and more than offset by spreading out to other states and actual loss due to mortality. In any event, for all practical purposes, the Pakistan-born persons in Punjab are as much Punjabis as those born in Punjab. If we exclude these persons from the migration stream, Punjab has net out-migration rather than in-migration as the figures would first indicate. In 1961, for example, Punjab has only 764,468 life-time in-migrants as against 1,318,813 life-time out-migrants.

B. ORISSA

1. Introduction

The State of Orissa is located on the east coast of India and has an area of 155,842 km^2. It has an extensive plateau in the interior with a foreground of wide coastal plain. The principal rivers of the central tract, the Mahanadi, the Brahmani and the Baitarani cut wide valleys across the plateau and bring down much sedimentary matter, forming the delta area. The state is the convenient point of convergence of monsoon currents from the Bay of Bengal and the Arabian Sea. The average annual rainfall in the state is about 150 cm. The potential natural resources of Orissa are many in the form of minerals (iron ore, coal, manganese, limestone, etc.), forests (nearly a third of the state is covered with forests of economic value), rivers (the major ones capable of providing large-scale opportunities for generation of hydroelectric power besides irrigation and fishing), and an extensive coast line (offering opportunities for ports, harbours and maritime trade). Yet, Orissa is one of the most backward states in India in terms of economic development.

2. Territorial coverage

The territorial boundaries of Orissa have undergone change from time to time in the last 70 years. At the turn of the century, Orissa was a Division of the Bengal Presidency and consisted of four districts – Cuttack, Puri, Balasore and Angul-cum Khondmals. There were also some 17 feudatory states within its jurisdiction. In 1905 Sambalpur district and 7 feudatory states were added to the Orissa Division. In 1912 the Bihar and Orissa Divisions were separated from the Bengal Presidency and formed a province. This composite province continued till 1936, when Bihar and Orissa became separate provinces. The area of Orissa province was increased by annexing some territory from the neighbouring Madras Presidency. One more district was added and extensive reorganization of the districts took place. The districts of Orissa province in 1936 were Cuttack, Puri, Balasore, Sambalpur, Ganjam and Koraput. In 1948 and 1949, all the princely states of Orissa were merged with the rest of Orissa. While some of these states were joined with existing districts, others were amalgamated to form new districts. Thus, 13 districts had been formed after the merger of former princely States.

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[15] The data on place of birth from the 1971 census are not yet available, so the analysis is confined to the period 1951-1961.

[16] Census of India, Paper No. 4 of 1954, *Displaced Persons – 1951 Census*, (New Delhi, Government of India Press, 1954), p. 42.

[17] Census of India, 1961, vol. XIII, *Punjab*, part 1-A(i), *General Report*, (Simla, Government of India Press, 1969), pp. 245-247.

The present analysis is based on these 13 districts which were formed before the 1951 census. No changes took place in the state or district boundaries during the 1951-1961 decade. There were some slight changes in the boundaries of the districts between 1961 and 1971, but adjustments were possible. The 13 districts are:

1. Sambalpur
2. Sundergarh
3. Keonjhar
4. Mayurbhanj
5. Balasore
6. Cuttack
7. Dhenkanal
8. Baudh Khondmals
9. Bolangir
10. Kalahandi
11. Koraput
12. Ganjam
13. Puri

However, it appears that Orissa of 1971 is radically different from what it was in 1901 or in 1921 or even in 1941. On account of the extensive changes in both state and district constitution, it is not possible to make exact adjustments for earlier censuses. However, an attempt was made in the 1971 census to obtain comparable figures at district level from 1901 onwards by making certain adjustments in population and also by assuming that the area of Orissa in earlier years was the same as in 1971. Estimates were then made of the population in those years for the transferred areas.[18] Thus, it is possible to build up population statistics for the districts of Orissa since 1901. However, it is not possible to obtain other demographic and economic data for the districts as they stood in 1971. For the princely states, some of the data are available only for all princely states as one unit. This in a sense imposes certain limitations on the study for the period prior to 1951. On the other hand, the figures on vital statistics in Orissa State have been notoriously unreliable, so that even the population figures and the growth rates for comparable units are valuable and provide a base for indirect estimation of vital rates.

3. Size and growth of population: 1901-1971

The population figures for Orissa State from 1901 to 1971 are given in table 11. At the turn of the century, the population of Orissa on the basis of present territorial jurisdiction is estimated to have been 10 million. Nearly 60 per cent of the people lived in the coastal districts of Balasore, Cuttack, Puri and Ganjam, or in about 26 per cent of the total area of the state. These districts have fertile agricultural land and irrigation facilities. Density of population was quite low in the inland region of Koraput, Kalahandi, Baudh Khondmals and portions of Sambalpur districts. This pattern which was evident in 1901 has continued up to now, although there is some indication of differential growth rates. According to the 1971 census, the coastal region (26 per cent of the total area of the state) has 47 per cent of the total population.

As indicated in table 12, the 1901-1911 decade witnessed some growth in population, although there was a series of floods resulting in failure of crops and outbreaks of cholera and fever. Consequently, the coastal districts were severely affected. The growth rates recorded by Puri and Cuttack were very low, while the population in Balasore decreased. It was hypothesized that the facilities of communication, such as railways, brought some ill-effects along with them and were instrumental in "disseminating what was known as Burdwan fever from Bengal to the adjoining areas of Balasore district."[19]

The 1911-1921 decade was one of disasters, epidemics, scarcity and high prices. The first few years of the decade were uneventful, but, from 1915 onwards, there were outbreaks of cholera and smallpox, culminating in 1918 in the influenza epidemic which proved most disastrous. In addition to these illnesses which resulted in high mortality, the state suffered a heavy flood in 1917 which washed away the crops. In the subsequent year the harvest was not good and the price of agricultural and industrial produce soared to high levels. The cumulative effect of all this was an actual decline in population during the decade. The coastal districts suffered heavily from the natural calamities. Some of the inland districts witnessed some gain in population, but in almost all cases it was quite small. On the whole, the population of Orissa declined by 1.9 per cent over the population of 1911.

The next decade was, on the whole, a period of relative prosperity. The state experienced an in-

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[18] Such adjustment was required for censuses prior to 1951. For an extensive discussion on the adjustments see: Census of India, 1971, Series 16 - *Orissa*, part II-A, *General Population Tables* (Cuttack, Orissa Government Press), pp. 101-103.

[19] Census of India, 1961, vol. XII, *Orissa*, part I-A (i), *General Report*, p. 77.

Table 11. Population of districts of Orissa, 1901-1971
(in thousands)

District	1901	1911	1921	1931	1941	1951	1961	1971
				Persons				
Sambalpur	789.3	913.9	955.4	1,067.7	1,202.6	1,301.8	1,508.7	1,844.9
Sundergarh	277.2	362.1	377.4	436.9	490.7	552.2	758.6	1,030.8
Keonjhar	285.8	364.7	379.5	460.6	529.8	588.4	743.3	955.5
Mayurbhanj	610.4	729.2	754.3	889.6	984.7	1,028.8	1,204.0	1,434.2
Balasore	1,140.1	1,124.3	1,045.7	1,059.2	1,108.8	1,106.0	1,415.9	1,830.5
Cuttack	2,205.3	2,258.7	2,195.3	2,336.9	2,447.0	2,528.2	3,063.1	3,827.7
Dhenkanal	570.6	589.4	513.9	634.0	740.0	837.1	1,026.6	1,293.9
Baudh Khondmals	334.0	378.0	376.4	411.7	450.1	456.9	514.4	621.7
Bolangir	447.6	624.4	721.2	804.8	871.8	917.9	1,068.7	1,263.7
Kalahandi	449.1	540.5	550.4	655.2	745.3	805.7	946.9	1,163.9
Koraput	722.8	869.0	841.9	992.8	1,177.0	1,322.6	1,561.1	2,043.3
Ganjam	1,142.0	1,269.7	1,228.5	1,391.1	1,560.7	1,624.8	1,872.5	2,293.8
Puri	1,328.8	1,354.8	1,218.8	1,350.6	1,459.6	1,575.4	1,865.1	2,340.9
Total	10,302.9	11,378.9	11,158.6	12,491.1	13,768.0	14,645.9	17,548.8	21,944.6
				Males				
Sambalpur	391.1	450.5	469.9	522.5	591.0	647.9	756.2	933.3
Sundengarh	141.5	182.1	188.3	217.0	243.3	274.4	396.2	530.8
Keonjhar	144.1	182.0	186.8	227.1	263.5	294.9	375.1	483.3
Mayurbhanj	303.3	362.6	374.3	442.4	491.1	514.1	604.8	721.9
Balasore	552.0	538.6	498.4	514.6	547.9	556.1	717.3	928.3
Cuttack	1,066.4	1,075.2	1,016.6	1,106.6	1,174.4	1,248.4	1,532.6	1,927.0
Dhenkanal	282.5	289.7	247.8	308.8	364.5	415.0	515.6	654.3
Baudh Khondmals	166.0	187.8	186.5	203.6	222.7	226.7	255.7	310.2
Bolangir	219.3	307.6	355.7	397.4	431.6	456.6	534.2	634.0
Kalahandi	224.2	267.1	271.0	321.9	366.3	399.0	468.8	578.9
Koraput	367.6	434.8	421.0	495.5	589.7	664.2	784.3	1,031.8
Ganjam	538.8	588.1	552.6	635.0	719.5	769.1	899.3	1,123.2
Puri	661.6	669.6	581.3	649.8	701.2	776.7	930.5	1,183.8
Total	5,058.1	5,535.6	5,350.2	6,042.3	6,706.5	7,242.9	8,770.6	11,041.1
				Females				
Sambalpur	398.2	463.4	485.5	545.2	611.6	653.9	752.5	911.6
Sundergarh	135.7	180.0	189.1	219.9	247.4	277.8	362.4	499.9
Keonjhar	141.7	182.7	192.7	233.5	266.3	293.5	368.2	472.2
Mayurbhanj	307.1	366.6	380.0	447.2	493.6	514.8	599.3	712.3
Balasore	588.1	585.7	547.4	544.6	560.9	549.6	698.6	902.2
Cuttack	1,138.9	1,183.6	1,178.7	1,230.2	1,272.5	1,279.9	1,530.5	1,900.6
Dhenkanal	288.2	299.8	266.1	325.3	375.6	422.2	510.9	639.6
Baudh Khondmals	168.1	190.3	189.8	208.1	227.4	230.2	258.7	311.4
Balangir	228.4	316.8	365.5	407.5	440.2	461.3	534.5	629.7
Kalahandi	225.0	273.4	279.3	333.3	379.1	406.7	478.1	584.9
Koraput	355.2	434.2	420.9	497.3	587.3	658.5	776.8	1,011.4
Ganjam	603.2	681.6	675.9	756.0	841.2	855.8	973.2	1,170.6
Puri	667.2	685.2	637.5	700.8	758.4	798.7	934.5	1,157.0
Total	5,244.8	5,843.2	5,808.4	6,448.8	7,061.5	7,403.1	8,778.3	10,903.5

Sources: Census of India, 1971, Series 16 — *Orissa,* part II-A, *General Population Tables,* (Cuttack, Orissa Government Press), pp. 107-111.

Table 12. Average annual rate of growth of population of districts of Orissa, 1901-1971

(in percentages)

District	1901-11	1911-21	1921-31	1931-41	1941-51	1951-61	1961-71	1901-51	1951-71
					Persons				
Sambalpur	1.47	0.44	1.11	1.19	0.79	1.47	2.01	1.00	1.74
Sundergarh	2.67	0.41	1.46	1.16	1.18	3.17	3.07	1.38	3.12
Keonjhar	2.45	0.40	1.94	1.40	1.05	2.34	2.51	1.44	2.42
Mayurbhanj	1.78	0.34	1.65	1.02	0.44	1.57	1.75	1.04	1.66
Balasore	-0.14	-0.72	0.13	0.46	-0.02	2.47	2.57	-0.06	2.52
Cuttack	0.24	-0.28	0.63	0.46	0.33	1.92	2.23	0.27	2.07
Dhenkanal	0.32	-1.37	2.10	1.55	1.23	2.04	2.31	0.77	2.18
Baudh Khondmals	1.24	-0.04	0.90	0.89	0.15	1.19	1.89	0.63	1.54
Bolangir	3.33	1.44	1.10	0.80	0.51	1.52	1.67	1.44	1.60
Kalahandi	1.85	0.18	1.74	1.29	0.78	1.61	2.06	1.17	1.84
Koraput	1.84	-0.32	1.65	1.70	1.17	1.66	2.69	1.21	2.17
Ganjam	1.06	-0.33	1.24	1.15	0.40	1.42	2.03	0.99	1.72
Puri	0.19	-1.06	1.03	0.78	0.76	1.69	2.27	0.34	1.98
Total	0.99	-0.19	1.13	0.97	0.62	1.81	2.23	0.70	2.02
					Males				
Sambalpur	1.42	0.42	1.07	1.24	0.92	1.56	2.13	1.01	1.84
Sundergarh	2.56	0.34	1.43	1.15	1.21	3.74	2.97	1.33	3.35
Keonjhar	2.37	0.26	1.98	1.49	1.13	2.43	2.57	1.44	2.50
Mayurbhanj	1.80	0.32	1.68	1.05	0.46	1.64	1.79	1.06	1.71
Balasore	-0.25	-0.77	0.32	0.63	0.15	2.58	2.61	0.01	2.60
Cuttack	0.08	-0.56	0.85	0.60	0.61	2.07	2.32	0.32	2.19
Dhenkanal	0.25	-1.55	2.22	1.67	1.31	2.19	2.41	0.77	2.30
Baudh Khondmals	1.24	-0.07	0.88	0.90	0.18	1.21	1.95	0.63	1.58
Bolangir	3.44	1.46	1.12	0.83	0.57	1.58	1.73	1.48	1.65
Kalahandi	1.77	0.15	1.73	1.30	0.86	1.63	2.13	1.16	1.88
Koraput	1.69	-0.32	1.64	1.75	1.20	1.68	2.78	1.19	2.23
Ganjam	0.88	-0.62	1.40	1.26	0.67	1.58	2.25	0.71	1.91
Puri	0.12	-1.40	1.12	0.76	1.03	1.82	2.44	0.32	2.13
Total	0.91	-0.34	1.22	1.05	0.77	1.93	2.33	0.72	2.13
					Females				
Sambalpur	1.53	0.47	1.17	1.16	0.67	1.41	1.94	1.00	1.67
Sundergarh	2.87	0.50	1.52	1.19	1.17	2.69	3.27	1.44	2.98
Keonjhar	2.57	0.54	1.94	1.32	0.98	2.29	2.52	1.47	2.41
Mayurbhanj	1.79	0.36	1.64	0.99	0.42	1.53	1.74	1.04	1.64
Balasore	-0.04	-0.67	-0.05	0.30	-0.20	2.42	2.59	-0.13	2.51
Cuttack	0.39	-0.04	0.43	0.34	0.06	1.80	2.19	0.23	2.00
Dhenkanal	0.39	-1.19	2.03	1.45	1.18	1.93	2.27	0.77	2.10
Baudh Khondmals	1.25	-0.02	0.92	0.89	0.12	1.18	1.87	0.63	1.52
Bolangir	3.33	1.44	1.09	0.78	0.47	1.48	1.65	1.42	1.57
Kalahandi	1.97	0.21	1.78	1.29	0.71	1.63	2.04	1.19	1.83
Koraput	2.03	-0.31	1.68	1.68	1.15	1.67	2.68	1.24	2.[illegible]7
Ganjam	1.23	-0.08	1.13	1.07	0.17	1.29	1.86	0.70	1.58
Puri	0.27	-0.72	0.95	0.79	0.52	1.58	2.16	0.36	1.87
Total	1.09	-0.06	1.05	0.91	0.47	1.72	2.19	0.69	1.95

Source: Based on table 11.

crease of 11.9 per cent (or average annual rate of 1.1 per cent) during 1921-1931, which was the highest increase recorded in Orissa since 1881. The crops were good except in the coastal areas. In addition to poor harvests, Balasore district lacked adequate public health facilities. In fact, the registration data indicated that the number of deaths exceeded the number of births during 1921-1927.[20] The population of Balasore recorded a very small increase compared with some of the inland districts.

As mentioned earlier, Orissa was constituted into a separate province in 1936, and Koraput and Ganjam districts, which were until then part of Madras Presidency, became a part of Orissa. Some portions of the Central Provinces were added to Sambalpur district. The decade 1931-1941 was generally peaceful and all the districts experienced some growth in their populations. The rate of growth of coastal districts was lower than the state average. The coastal area of Orissa has generally been subject to heavy floods and even occasional cyclones. The floods in 1933 and 1937 adversely affected agricultural production by depositing sand on agricultural lands. The cyclone of 1940 damaged crops in Puri and Ganjam districts.

While the level of mortality began to decline all over the country after 1921, as reflected in the acceleration of the growth rate, Orissa suffered a setback during 1941-1951. The floods in the rivers of Balasore district damaged the crops at the beginning of the decade. After a severe cyclone in 1942, this district was caught in severe famine and, in 1943, it experienced a mortality rate that was 40.7 per cent higher than the quinquennial average.[21] The state as a whole also suffered from epidemics of cholera and malaria. In addition, there were food shortages, migration and the influx of famine-stricken people from Bengal. The latter half of the decade was relatively better in terms of both agriculture and health, but the effect of the unfavourable weather, natural conditions, etc. lingered on and the rate of population growth was lowered. It dropped to 6.2 per cent during the 1941-1951 decade from nearly 10 per cent during the previous decade. In fact, in terms of absolute number, Balasore district experienced an actual decline in its population, while the annual growth rate in Baudh Khondmals, Ganjam and Cuttack, Mayurbhanj, and Bolangir districts was lower than the state average of 0.62 per cent.

Viewing the 50-year period from 1901 to 1951 as a whole, the population of Orissa grew at a rather slow rate; the average annual growth rate was 0.7 per cent. There were sizable interdistrict variations in growth of population. As brought out above, the coastal districts grew at a slower rate than the inland region. The coastal districts, in spite of their potentially good agricultural land, were victims of a series of natural calamities such as cyclones and floods. Baudh Khondmals district also experienced a slow growth rate during 1901-1951. The villages in this region, inhabited by tribal communities, did not benefit from development projects or extension of medical and other facilities. There may have been some out-migration from this area which further depleted the population.

4. Growth of population 1951-1971

After 1951, the population of Orissa showed a significant increase compared with the earlier decades. During 1951-1961, the population grew at an average annual rate of 1.8 per cent, a rate unprecedented in the history of Orissa. In absolute terms, a gain of 3 million in population was achieved in 10 years while it had taken four decades, from 1911 to 1951, to gain 3 million. However, various districts within the state, with their own distinctive geographic, social, cultural and economic patterns, indicated differentials in growth rate.

It is interesting to note that the districts which had experienced slow growth up to 1951 picked up momentum and showed a substantial increase in their population. Balasore, Puri and Cuttack districts, in particular, experienced a growth rate which was considerably higher than in the past. Special measures were taken for the improvement of public health and the eradication of malaria. Although floods and cyclones continued to cause havoc to the agricultural crops, their ill-effects were minimized to a great extent by improvements in distribution channels and over-all developmental activities. Along with irrigation works, flood protection measures were taken up to combat the situation. On the other hand, Baudh Khondmals district, traditionally a slow-growing area, continued to grow at a slow rate. Although special schemes for the welfare of the tribal people were introduced, the irrigation and other agricultural facilities were not extensive or modernized.

Sundergarh district, which recorded the highest growth rate during 1951-1961, had enjoyed scope for agricultural expansion in the past also. The construction and expansion of railway lines, partly in response to the limestone and manganese mines, had brought in some migrants to work in the mines. The modern large-scale steel plant at Rourkela as well as other industrial development resulted in a very high growth rate during 1951-1961.[22] This growth was largely due to immigration from other districts as well as other states.

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[20] Census of India, 1961, vol. XII, *Ibid*, p. 78.

[21] Famine Enquiry Commission, 1945, *Report on Bengal*, p. 144.

The other two districts whose average annual rate of growth was higher than the state average were Keonjhar and Dhenkanal. In Keonjhar district, a number of minor irrigation works were executed and improved techniques of agriculture were adopted. Also, the road network was developed extensively for the transport of manganese ores. These developments contributed to the material prosperity of the people. In Dhenkanal, the epidemic diseases were brought under control by supplying drinking water in rural areas. These and other measures, such as public health schemes, helped reduce mortality and contributed to population growth.

During 1961-1971, the interdistrict variations in population growth continued. Sundergarh experienced an average annual growth rate of more than 3 per cent. The growth rate of Balasore, Keonjhar and Dhenkanal was above the average for the state as a whole. On the other hand, some of the districts with a large component of tribal population, such as Baudh Khondmals and Mayurbhani, experienced slow growth.[23] Although there was some improvement over the previous decade, their growth rate was less than 2 per cent per annum. The other two districts with high tribal population are Sundergarh (53.4 per cent) and Koraput (56.3 per cent). However, they both experienced some economic development, the latter also benefiting from the Machkund hydroelectric project. Social welfare schemes for the uplift of the tribal people were also undertaken in both districts.

5. Population growth in rural areas

As indicated earlier, it is not possible to estimate rural or urban growth rates at district level because of boundary changes, although estimates at state level are possible. In table 13, the rural-urban composition, the proportionate share and the growth rate of population are given f[illegible]issa State from 1901 to 1971. In Orissa, the [illegible]ban population contributed only about 2.5 per cent of the total population in 1901 and it remained at that level until 1931. This indicates that there was practically no urbanization in Orissa during 1901-1931 and the growth rates of rural and urban population were essentially the same. It is only after 1931 that the share of urban population in the total started to increase, first gradually and since 1951 quite rapidly. The urban growth rate during the decade 1951-1961 was 6.25 per cent per year. Conversely, the rural growth rate was lower than the state average. However, the percentage of urban population to total population increased from 4.1 per cent in 1951 to 6.3 per cent in 1961. By 1971, it had reached 8.4 per cent. It is between 1951 and 1971 that the growth rate of rural population was somewhat smaller than that of the total population. But for all practical purposes, at the state level, the impact of urban population would be negligible. However, for a particular district which has experienced a rapid increase in its urban population, this factor would have to be reckoned with, and the impact of urbanization, if any, on population and agricultural change will be brought out in subsequent discussion.

Table 13. Proportion of population urban and rural and the intercensal rate of growth in Orissa State, 1901-1971

Census year	Total population	Urban population	Rural population	Percentage urban	Percentage rural	Average annual growth rate	
						Urban	Rural
1901	10,302,917	254,684	10,048,233	2.5	97.5		
1911	11,378,875	275,159	11,103,716	2.4	97.6	0.77	1.00
1921	11,158,586	281,498	10,877,088	2.5	97.5	0.23	-0.21
1931	12,491,056	317,254	12,173,802	2.5	97.5	1.20	1.13
1941	13,767,988	412,528	13,355,460	3.0	97.0	2.63	0.93
1951	14,645,946	594,070	14,051,876	4.1	95.9	3.65	0.51
1961	17,548,846	1,109,650	16,439,196	6.3	93.7	6.25	1.57
1971	21,944,615	1,845,395	20,099,220	8.4	91.6	5.09	2.01

Source: Census of India, 1971, Series 16 - ***Orissa***, part IIA ***General Population Tables***, (Cuttack, Orissa Government Press), p. 170.

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[22] In fact, the population of Rourkela town increased from 18,800 in 1951 to 90,300 in 1961 or a growth of 480.2 per cent.

[23] The proportion of scheduled tribe population in the total population of Baudh Khondmals and Mayurbhanj was 40.3 and 58.6 per cent respectively, according to the 1971 census. In Orissa State as a whole, the proportion of tribal population was 23.1 per cent. See: Census of India, 1971, Orissa, *General Population Tables*, pp. 226-227.

6. Factors affecting population growth

From the census data on population size, although it is easy to obtain the intercensal rates of growth, it is often not easy to obtain the values of the components of population change - fertility, mortality and migration. The registration system, if fairly complete and reliable, would provide estimates of fertility and mortality. However, in the State of Orissa, the registration has been rather deficient and incomplete. Although the registration system was given legal sanction in some parts as early as 1873[24] and subsequently extended to other parts, in 1951 it was limited to 36 per cent of the area of the state comprising 54 per cent of the total population. Of course, by 1961, the area of registration had been considerably extended and covered the entire state except parts of Koraput and Ganjam districts.

Thus, it is evident that, prior to 1960, the available statistics on vital rates are very limited in scope. However, some data secured from the District Gazetteers are given in table 14. For the decade 1921-1930, figures are available only for Sambalpur and Cuttack districts. They suggest a birth rate around 40 and a death rate around 30. For the decade 1931-1940, figures are available for certain years only — 1931-1933 and 1936-1940. Birth and death rates were around 35 and 30, respectively. Quite possibly, births were more under-registered than deaths. As they are,

Table 14. Registered birth and death rates in some districts in Orissa, 1921-1930 and 1931-1947

Year	Cuttack		Sambalpur	
	Birth rate	Death rate	Birth rate	Death rate
1921	-	-	38.1	33.6
1922	41.3	30.2	35.2	24.6
1923	42.2	33.4	41.8	26.2
1924	36.1	40.1	37.3	26.5
1925	32.4	38.6	39.4	26.2
1926	31.3	36.2	38.3	27.7
1927	33.6	29.5	36.3	27.2
1928	39.5	30.9	41.2	26.5
1929	35.6	32.4	37.1	26.8
1930	38.4	28.3	40.5	26.9

Year	Cuttack		Balasore		Puri		Sambalpur	
	Birth rate	Death rate	Birth rate	Death rate	Birth rate	Death rate	Birth rate	Death rate
1931	36.2	35.8	34.8	35.5	38.1	31.2	34.3	26.4
1932	38.0	26.3	29.6	27.0	36.3	25.1	27.9	19.6
1933	37.8	35.7	34.7	35.1	41.3	32.2	32.8	20.2
1936	36.9	30.6	32.8	32.0	34.8	26.4	34.0	24.5
1937	33.3	30.9	30.5	31.7	35.1	28.5	35.4	24.1
1938	32.4	31.6	29.6	33.7	33.5	30.0	32.4	24.4
1939	32.8	32.1	31.7	27.7	32.5	28.6	35.1	24.2
1940	37.0	24.9	35.7	25.8	33.8	24.7	32.3	21.4
1943	33.2	30.6	31.8	39.2	31.0	33.8	30.1	24.6
1944	26.8	35.7	24.8	26.6	26.6	32.5	31.3	23.6
1946	28.7	30.5	29.9	27.5	29.4	25.0	27.1	23.5
1947	28.0	31.5	27.8	34.4	28.7	28.7	29.3	30.5

Source: Data derived from the respective District Gazetteers.

Note: Birth and death rates were not available for all the years between 1931 and the year of independence. Figures are given for those years for which data were available.

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[24] Legal sanction for the registration of births and deaths was obtained when the Bengal Births and Deaths Registration Act of 1873 and the Madras Births and Deaths Registration Act of 1899 became operative in the territories now covered by North and South Orissa, respectively.

the district figures do not show much decline in the level of death rate when compared with the previous decade. Assuming that the level of fertility did not change during this period in any significant way, changes in the growth rate would be a function of death rate and net migration rate. In fact, the intercensal growth rate during 1931-1941 was slightly lower than for 1921-1931, thereby indirectly confirming that the death rate had not declined much, if at all.[25] **Data available for the same four districts—Cuttack, Balasore, Puri and Sambalpur—for some of** the years in the 1940s show lower birth rates than the previous decades. This seems to be due to deterioration in registration. Registered death rates in most cases are between 30 and 35. It seems fairly clear that the state experienced a high death rate during the 1941-1951 decade, and this would explain the low growth rate of 6.2 for the decade.

7. Vital rates: 1951-1971

The registered birth and death rates for 1951, 1955, 1960 and the average for the decade 1951-1960 are given in table 15. They clearly indicate how deficient the registration system in Orissa was. The efficiency in certain districts appears to be greater than in others. It is generally believed that the long tradition of registration in the former British districts has enabled these districts to develop better reporting system than the former princely states. However, in the case of Orissa, the data for the post-independence period do not suggest better reporting in Cuttack, Puri, Balasore or Sambalpur districts than in some others which were earlier princely states. Also the deficiency seems greater in reporting births than in deaths, although the latter are also probably under-reported to a certain extent. However, it is clear that the registered rates are not useful for analysing either the time trend or interdistrict variations.

Since registration data in Orissa are inadequate for purposes of determining trends in fertility and mortality, an attempt was made to indirectly estimate the vital rates by using the reverse survival method outlined in annex I. For estimating vital rates for Orissa, the 1951-1960 Eastern Zonal life table was used to project the 1951 census smoothed population separately for males and females. It was found that the projected male population was short of the actual by 138,900 and the

Table 15. Registered birth and death rates for the 13 districts of Orissa in 1951, 1955 and 1960

District	1951		1955		1960		1951-1960	
	Birth rate	Death rate	Birth rate	Death rate	Birth rate	Death rate	Birth rate	Death rate
Sambalpur	25.3	19.1	30.3	17.8	24.7	13.9	26.2	17.0
Sundergarh	29.0[a]	18.4[a]	28.5	15.4	19.7	9.6	23.3	13.7
Keonjhar	30.6[a]	17.5[a]	32.2	14.4	28.2	15.4	28.0	15.9
Mayurbhanj	24.1[a]	14.6[a]	21.7	10.8	25.1	13.9	23.0	13.6
Balasore	23.4	21.5	20.5	9.5	25.8	11.5	23.3	12.9
Cuttack	23.7	21.1	29.5	14.0	21.7	13.2	27.0	17.1
Dhenkanal	31.0	18.0	29.9	14.7	27.9	15.5	27.9	16.0
Baudh Khondmals	8.6	7.9	17.0	10.9	11.[illegible]	7.5	13.1	9.8
Bolangir	41.0[a]	29.9[a]	46.5	22.7	27.7	15.4	34.1	21.8
Kalahandi	33.9[a]	21.6[a]	34.5	18.6	33.2	16.9	30.2	19.6
Koraput	14.6	7.6	9.8	5.7	11.9	6.6	11.3	7.9
Ganjam	29.4	26.6	24.0	13.4	19.3	10.2	24.6	16.3
Puri	28.9	23.2	24.2	12.0	24.5	15.6	24.4	16.2
Total	24.6	21.0	28.1	14.3	24.1	13.4	25.8	16.2

Sources: (1) Census of India, 1961, vol. XII, *Orissa*, part I-B *Report on Vital Statistics and Fertility Survey*.

(2) Census of India, 1961, Vol. XII, *Orissa*, part I-A (i), *General Report*, pp. 119-120.

[a] Rate for 1951 not available, so rate for 1952 given.

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[25] It is not possible to make estimates of net migration rates at district level, given the inadequate data on vital rates, although it is conceded that it can be a very important factor affecting growth rate.

Table 16. Estimated birth rates and child-woman ratios for 13 districts of Orissa, 1951-1971

District	1951-1961	1961	1961-1971	1971
	Birth rate	Child-woman ratio	Birth rate	Child-woman ratio
Sambalpur	35.8	1.45	36.7	1.67
Sundergarh	42.2	1.68	45.0	1.96
Keonjhar	44.8	1.82	47.9	2.02
Mayurbhanj	43.2	1.75	42.0	1.97
Balasore	41.5	1.64	46.1	2.13
Cuttack	38.0	1.56	40.5	1.88
Dhenkanal	43.4	1.86	44.0	2.03
Baudh Khondmals	38.4	1.58	41.0	1.79
Bolangir	39.5	1.67	38.7	1.78
Kalahandi	43.7	1.82	43.0	2.03
Koraput	35.1	1.41	44.0	1.78
Ganjam	40.5	1.66	40.0	1.95
Puri	37.5	1.60	40.0	1.83
Total	39.6	—	—	—

Sources: (1) Census of India, 1961, vol. XII, ***Orissa***, part II-A. *General Population Tables.*
(2) Census of India, 1971, provisional tables prepared on the basis of one per cent sample.

Note: Estimates are based on the forward survival technique.

female population was in excess of the actual by 41,300. These figures may be taken as estimates of net migration gain between 1951 and 1961 in population aged 15 and over.

The estimate of migrants in the total population was obtained by multiplying the above estimated number of migrants aged 15 and over by the 1961 ratio of total population to population aged 15 years and over.[26] This gives net in-migration of 229,200 males and net out-migration of 69,300 females. As will be indicated later, actual net in-migration amounted to 68,500 males and 61,200 females.[27] Thus, it seems that the Life Table underestimates the male population of 1961 by 160,700 and overestimates the female population by 120,500. The selected Life Table in the case of Orissa does not fit with the actual experience as closely as it did in the case of Punjab, but, in the absence of anything better, it has been used in the subsequent calculations.

The smoothed 1961 population of Orissa below age 10 in single years was projected back by the life table to obtain births in the preceding 10 years. By this method, the estimated birth rate for the state as a whole for 1951-1961 works out at 39.6. The technique was applied to all the districts and the estimates of birth rate obtained are presented in table 16 along with the estimates for the decade 1961-1971. The estimated birth rates during both periods are above 40 in most of the districts. There are very little interdistrict variations. It is quite likely that the relatively low estimates obtained for Koraput, Sambalpur, Puri and Cuttack (birth rate between 35 and 38) are due to the methodological limitations of the estimates. The 1961-1971 estimates for these areas, except for Sambalpur, suggest that the birth rate has increased slightly.

8. Migration

Migration has not played a significant role in the growth of the population in Orissa. As is evident from table 17, the in-migrants to Orissa formed only about 2.2 per cent of the total population in 1961. However, the life-time out-migrants outnumbered the in-migrants, with the result that net migration had a small negative effect on over-all population growth. The difference between out-migrants and in-migrants was smaller in 1961 than in 1951, suggesting that the people were increasingly choos-

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[26] This assumes that the proportion of children among the in-migrants was the same as in the total population. Such an assumption is perhaps unwarranted but is made to obtain some rough estimates of migration gain.

[27] As a proportion to the total population, the migrants form a very insignificant part. Roughly speaking, the 129,700 in-migrants form only about 0.7 per cent of the total 1961 population of Orissa State.

Table 17. Number of in-migrants to and out-migrants from Orissa, 1951 and 1961

	Year	Persons	Males	Females
Life-time in-migrants to Orissa	1951	196,788	106,170	90,618
	1961	381,869	178,458	203,411
Life-time out-migrants from Orissa to other states in India	1951	416,515	267,819	148,696
	1961	471,889	271,624	200,265
Net migration (out = -, in = +)	1951	-219,727	-161,649	-58,078
	1961	-90,020	-93,166	+3,146

Source: Census of India, 1961, vol. XII, *Orissa, Part II-C(ii), Migration Tables*

ing to stay on in their home state. This phenomenon can be expressed in another way by differencing the birth-place data of the 1951 and 1961 censuses. In-migration increased at a much faster rate than out-migration during 1951-1961.[28]

As in the case of Punjab, out-migration data at district level are not available for Orissa. It is therefore not possible to isolate the effect of migration on the change in the observed population growth of various districts in 1951-1961. Quite likely, the migration was very small. Since Orissa is poorly industrialized, the main factor which would encourage people to migrate is agricultural settlement on newly developed areas. In the coastal districts of Balasore, Puri, Cuttack and Ganjam (plains), part of the population increase is presumably due to settlement in new areas, although the number of new settlers is a matter of surmise. The land records give information only regarding areas of land brought under new settlements but not the number of persons actually settled.

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[28] Since birth-place data from the 1971 census are not yet available, migration change during 1961-1971 cannot be estimated.

II CHANGES IN AGRICULTURE

This chapter highlights the main features of agricultural development in the period covered by the study. It covers the changes in agricultural output, area and productivity, both in the aggregate and for individual crops. Analysis of the factors affecting agricultural output and yield is attempted in a later chapter.

The analysis of agricultural change like the analysis of population change, covers two time periods: 1901-1951 and 1951-1971. Since 1951, there has been a precipitate fall in the death rate resulting from the adoption of increasingly effective public health measures and the widespread use of sulpha drugs and antibiotics. Consequently, the rate of population growth accelerated throughout the country. The system of planning, although of a mixed type, was introduced in 1951 in place of the unrestrained market mechanism of resource allocation that operated earlier. This marks a turning-point in the development of the Indian economy. Thus, since 1951 there have been significant changes in both the institutional framework of the Indian economy and the size and structure of India's population.

SECTION 1 — GROWTH OF AGRICULTURE: 1901-1951

A. PUNJAB

Analysis of agricultural change for the period 1901-1951 is seriously handicapped by the limitations of available data. In British India, data on agriculture were brought out regularly, while those for the princely states were collected irregularly and inadequately and were also less reliable. The analysis that follows is therefore restricted to the same 12 districts of Punjab in respect of which the analysis of population change was made in the preceding chapter. The total figures for Punjab are the weighted averages of the data for the 12 districts and not those of undivided Punjab.

Data on area and output of principal crops, pattern of land utilization and irrigation for the period 1911-1951 were obtained from Season and Crop Reports, Office of the Director of Land Records, Government of Punjab. The measure of agricultural output is based on 10 crops: rice, wheat, jowar, bajra, barley, maize, gram, sugarcane, cotton (desi) and cotton (American) for which data were available. It does not include ragi, small millets, other pulses, potatoes, groundnuts, rapeseed, mustard, sesame, linseed, tobacco, chillies and tea. The comparability, though obviously restricted, is not much vitiated since the crops not covered in the earlier reports accounted for only 11 per cent of the total output and 8 per cent of the cultivated area as obtained on the basis of coverage for the years 1951-1954.

To maintain comparability over time, physical outputs of crops were multiplied by their respective prices.[1] To secure comparable data for the years 1939-1941 and 1951-1954, the value of total output for the latter years was also calculated on the basis of 10 crops for which data were available for earlier years. Physical outputs during the period were estimated on the *'anna-wari'* basis i.e. on the judgement of the local officers regarding the proportion of actual production in a year to what was considered to be the normal yield per acre. Comparability is limited by the obvious bias of personal judgement. Boundary adjustments between districts can also pose a problem of comparability. However, minor territorial changes, for which it was occasionally not possible to adjust population figures, are ignored in the case of agricultural data. In the wake of Partition, the shifts in population involved almost wholly movements of minorities to and from each of the partitioned countries. This movement was not related to any changes in agriculture, so that the mass migration is of no analytical significance for the present study.

The growth rates of output, acreage and productivity are computed as annual compound rates based on the initial and final year values. To minimize biases in the data caused by annual fluctuations, three-year averages round the census year were taken, i.e. 1939/40, 1940/41, and 1941/42 for 1941; 1929/30, 1930/31 and 1931/32 for 1931; and so on.[2]

Data on work force are available from the census reports of 1911, 1921 and 1931. The work force data of the 1941 census were not tabulated; therefore, estimates were obtained by applying the mean of worker-population ratios and agricultural-total worker ratios of 1931 and 1951 to the population as of 1941.

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[1] For the computation of the prices used as weights, see annex II.

[2] For the years around 1911, however, data were available for only two years 1909/10 and 1911/12. The averages of these two years are used.

Since the quality of the data is not very satisfactory, an attempt has been made in this section to present a sweeping review of changes in agriculture from 1901 to 1951. It is hoped that this review will provide a perspective for the study of changes that followed the advent of planning.

1. Growth rates: Output, area, productivity

Growth rates of output, area and productivity in Punjab are presented in table 18. It may be noted that there was virtual stagnation in agriculture in the period 1911-1941. Aggregate output actually declined by 1.7 per cent per annum in the decade 1911-1921, and by a further 0.4 per cent in the following decade. In 1931-1941, however, the trend was reversed although only by a slight margin; the annual compound rate of growth in agricultural output was 0.4 per cent. In the decade 1941-1951, however, the rate of increase of output rose to a high level of 3.1 per cent per annum.

Changes in area during the entire period of 40 years before 1951 were only marginal and played a comparatively insignificant role in the over-all development of agriculture in the state. In the decades 1911-1921 and 1931-1941, the area under the crops covered showed an annual decline of 0.4 and 0.5 per cent respectively, while, in the decades 1921-1931 and 1941-1951, there was a marginal increase of 0.3 and 0.2 per cent per annum respectively.

Output per hectare declined from Rs 255 in the year 1911 to Rs 223 in 1921 and further to Rs 207 in 1931. The process was reversed in the two succeeding decades. Between 1931 and 1941, the productivity increased by 0.9 per cent per annum,

Table 18. Annual rates of growth and changes in area and output per hectare in agriculture, Punjab, 12 districts, 1909-1912 to 1951-1954

District	Output	Area	Productivity	Output per hectare (Rs)		Output	Area	Productivity	Output per hectare (Rs)	
				Base	Final				Base	Final
			1909-1912 to 1919-1922					**1919-1922 to 1929-1932**		
Hissar	-5.1	0.7	-5.8	180.4	99.6	1.2	0.9	0.3	99.6	102.2
Rohtak	0.9	2.2	-1.3	241.7	212.0	-5.4	-0.8	-4.6	212.0	132.4
Gurgaon	-3.4	-0.2	-3.3	191.8	136.6	1.1	0.8	0.3	136.6	141.2
Karnal	2.5	-0.1	2.5	188.5	242.2	-4.0	-0.6	-3.5	242.2	170.1
Ambala	-5.1	-1.1	-3.9	286.4	192.0	0.1	0.5	-0.4	192.0	185.1
Kangra	-2.6	-0.4	-2.2	224.9	180.9	1.4	-0.5	1.9	180.9	219.0
Hoshiarpur	0.9	-0.2	1.1	217.7	242.9	1.4	-0.2	1.6	242.9	283.9
Jullundur	-1.1	-1.6	0.5	405.2	423.8	0.2	0.7	-0.5	423.8	403.6
Ludhiana	1.3	-1.4	2.7	230.6	300.7	0.7	0.7	0.0	300.7	301.2
Ferozepur	-3.6	-1.5	-2.1	276.0	222.6	0.6	1.0	-0.4	222.6	214.4
Amritsar	-1.8	-1.6	-0.2	383.5	374.4	0.1	0.4	-0.3	374.4	363.7
Gurdaspur	-0.9	-0.7	-0.2	355.8	348.4	-0.0	0.7	-0.7	384.4	322.3
Total	-1.7	-0.4	-1.3	255.0	223.4	-0.4	0.3	-0.7	223.4	207.3
			1929-1932 to 1939-1942					**1939-1942 to 1951-1954**		
Hissar	-5.1	-1.9	-3.2	102.2	73.6	9.4	1.3	8.0	73.6	179.1
Rohtak	2.6	-0.8	3.5	132.4	186.2	4.7	0.6	4.0	186.2	289.8
Gurgaon	-0.6	0.2	-0.8	141.3	131.0	3.1	-0.1	3.2	131.0	191.0
Karnal	1.5	-0.6	2.1	170.1	209.8	6.3	1.9	4.3	209.8	348.7
Ambala	0.3	-0.1	0.4	185.1	192.0	4.9	-0.5	5.3	192.0	333.6
Kangra	-0.1	0.4	-0.6	219.0	206.7	4.0	-1.1	5.2	206.7	378.1
Hoshiarpur	-0.5	0.1	-0.7	283.9	265.4	0.9	-0.3	1.3	265.4	308.9
Jullundur	0.0	-0.3	0.3	403.6	416.3	0.4	-1.2	1.6	416.3	500.9
Ludhiana	1.6	-0.3	1.9	301.2	363.6	0.9	-1.2	2.0	363.6	446.8
Ferozepur	1.0	-1.1	2.2	214.5	265.7	1.9	0.2	1.6	265.7	325.7
Amritsar	0.0	-0.2	0.2	363.7	372.4	1.9	1.3	0.5	372.4	396.9
Gurdaspur	0.8	0.7	0.2	322.3	327.5	-2.1	-3.2	1.2	327.5	377.3
Total	0.4	-0.5	0.9	207.3	227.8	3.1	0.2	3.0	227.8	324.9

Source: The study team obtained the data on which these rates of growth are based from the "Season and Crop Reports" for Punjab State.

while, in the period 1939-1942 to 1951-1954, it recorded an increase of 3 per cent per annum, so that, by 1951-1954, output per hectare was Rs 325.

The table also brings out striking interdistrict variations in the levels of agricultural productivity as well as growth rates in different decades. Jullundur, Amritsar and Gurdaspur appeared agriculturally the most prosperous districts of Punjab in the base period 1909-1912, recording an average output per hectare of Rs 405, Rs 384 and Rs 356 respectively. At the other end, Hissar, Gurgaon and Karnal showed the lowest productivity, ranging from Rs 180 to Rs 192. The remaining districts fell in the middle group, showing levels of productivity which were close to the weighted average for the state.

The record of growth in agriculture in the first decade of the study, commencing 1909-1912, appeared very poor. There were only four districts which showed some growth, the highest recorded by Karnal being only 2.5 per cent per annum. Of the eight districts showing an actual fall in aggregate, Hissar (-5.8 per cent) and Ambala (-3.9 per cent) recorded the largest declines, the former also experiencing the lowest yield per hectare.

As observed at the state level, changes in area were comparatively less significant in most districts. However, in Amritsar and Jullundur, the decline in aggregate output was mainly on account of reduction in acreage. Rohtak is the only district which achieved an increase of 2.2 per cent per annum in area under the crops. Productivity change was a major factor elsewhere. Thus, Karnal and Ludhiana, the two districts recording the highest growth in output, also showed a significant increase in productivity. Similarly, a decline in productivity was the main factor in all those districts which showed a striking fall in output during this decade.

The decade 1919-1922 to 1929-1932 was also a period of agricultural stagnation. Rohtak and Karnal recorded a striking decline in output of 5.4 and 4.4 per cent per annum respectively, mainly due to a fall in productivity. Hissar, Gurgaon, Kangra and Hoshiarpur showed a small increase, ranging from 1.1 to 1.4 per cent per annum. In the first two, it was largely due to increase in area; in the latter two, however, it was increase in the yields per unit which even outweighed the aggregate growth rates. Other districts did not show changes of any marked significance.

The notable feature of the decade 1929-1932 to 1939-1942 is a significant decline of over 5 per cent per annum in agricultural output in Hissar which occurred on account of a fall in both area and productivity. Rohtak recorded an increase in output of the order of 2.6 per cent per annum which was attained in spite of a fall of 0.8 per cent per annum in acreage. Karnal recorded a growth rate of 1.5 per cent per annum in aggregate output, mainly on account of a rise in output per acre. Small increases in total output, ranging from 1.0 to 1.6 per cent per annum, were also observed in Ludhiana and Ferozepur in spite of a fall in acreage which evidently implied a relatively faster rise in productivity. Variations over the decade in other districts were of a minor order.

The period 1939-1942 to 1951-1954 presents several features of interest. Hissar, where output per acre had declined from Rs 73 in the initial triennium to Rs 30 by 1939-1942, recorded a phenomenal gain in output of 8 per cent per annum, out of which the productivity component alone was as high as 7.1 per cent. Striking increases in output as well as in productivity were observed in Rohtak, Gurgaon, Karnal, Ambala and Kangra. A fact of analytical significance which emerges is that all the districts which show relatively high rates of increase in output and productivity had a significantly lower output per hectare in the base period. On the other hand, the remaining districts, which had relatively high initial levels of productivity, showed significantly lower rates of growth during this period. The coefficient of correlation between output per hectare in 1939-1942 and the change in productivity during this period was as high as -0.82.

In spite of its long tradition, canal irrigation is fairly unevenly distributed among various districts of Punjab. The southern districts of Hissar, Rohtak and Gurgaon are dry and receive only about 40 to 55 cm of rain annually. The region is semi-desert and without any important rivers or drainage lines. Consequently, agriculture in this region was mainly dependent on the monsoon rains. The scanty rainfall coupled with the absence of any major irrigation scheme partly explains their low output. In addition to these factors, the failure of the rains, resulting in drought and famines, was often responsible for low output and productivity. In the northern districts, such as Amritsar, Jullundur, Ludhiana and Gurdaspur, a high proportion of net sown area receives irrigation. The perennial rivers of Punjab traverse this region where canal irrigation has been used extensively. This phenomenon

Table 19. Average annual rates of change in output, area and productivity of certain crops in Punjab, 1911-1951

Crop	1911-1921			1921-1931			1931-1941			1941-1951		
	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity
Rice	3.0	1.3	1.8	0.9	-0.8	1.7	-0.6	0.6	-1.2	5.2	3.2	2.1
Wheat	-0.6	-1.2	0.5	1.1	0.9	0.4	0.3	0.2	0.1	1.1	-0.3	1.6
Barley	-1.5	-1.6	0.2	-2.2	-4.2	6.4	2.0	0.8	1.2	-0.3	-1.2	0.8
Jowar	6.2	3.6	2.7	-10.6	-1.7	-8.8	-1.2	-2.5	1.3	8.7	3.3	5.3
Bajra	2.3	4.0	-1.6	0.3	0.1	0.2	-1.2	3.2	-4.4	6.6	-0.6	7.4
Maize	3.2	1.1	2.0	-1.0	-0.4	-0.6	1.0	0.9	0.1	1.9	-0.7	2.7
Sugarcane	4.5	2.4	2.0	-3.6	-2.8	-0.8	4.0	3.3	0.7	8.1	2.1	5.9
Cotton	4.2	-0.1	4.5	2.6	2.8	-0.3	2.5	-0.1	2.6	-5.2	-6.8	1.7
Gram	-3.4	-1.6	-1.9	-0.3	0.2	-0.5	-3.4	-3.1	-0.3	6.0	2.4	3.7

Source: Statistics on area and production or output are available for a fairly large number of crops and are published in ***Estimates of Area and Production of Principal Crops*** issued by the Directorate of Economics and Statistics.

is reflected in the high initial level of productivity in these districts.

2. Growth rate for different crops

Time trends in output of different crops, area and productivity are given in table 19. In the first decade, i.e. 1911-1921 the decline in aggregate output at the state level was mainly due to a fall in the production of wheat, barley and gram. A decline in acreage was a relatively more important factor in regard to wheat and barley, while the productivity effect outweighed that of area in causing a significant reduction in the output of gram. Other crops, viz. rice, jowar, bajra, sugarcane and cotton, recorded an increase ranging from 2.3 to 6.2 per cent, but the area under these crops and the output were too low to counteract the over-all decline in the agricultural output of the state during this decade.

The second decade again saw a decline in the production of several crops, notably barley, jowar, maize, sugarcane and gram. Wheat, which was the most important crop in the state, showed a small increase of 1.1 per cent per annum during 1921-1931. Cotton and rice also recorded gains of the order of 2.6 and 0.9 per cent respectively.

During the decade 1931-1941, a perceptible decline of 3.4 per cent per annum is observed in the output of gram largely due to a fall in acreage under this crop. Both jowar and bajra showed a decline of 1.2 per cent per annum and rice one of 0.6 per cent. On the other hand, wheat, barley, maize, cotton and sugarcane recorded positive gains, although in varying degrees; the highest rate of growth (4 per cent per annum) being observed in the case of sugarcane.

The period 1939-1942 to 1951-1954 saw a significant increase of 5 to 6 per cent in the output of several crops. The notable exceptions were wheat, barley, maize and cotton. Wheat and maize registered a small increase of 1.1 and 1.9 per cent respectively. A striking decline in output (5.2 per cent per annum) was noted only for cotton (desi). Productivity was a comparatively more important factor in contributing to the high rates of growth for some crops.

3. Shifts in the crop pattern

The first five crops ranked in order of their respective shares in output and area are given in table 20. They do not indicate any significant change in the crop pattern. Wheat and gram remained dominant crops in Punjab throughout the period 1911-1951 in terms of their respective shares in both output and area. The only exception was a substitution of bajra for gram in area in 1939-1942. Bajra normally ranked as the third crop in order of area, but it ranked number five in order of output. In fact, in terms of output, it was not even included among the first five crops in 1939-1942. Barley was cultivated as a major crop in 7 to 8 per cent of the area in the first two triennia, but dropped after that. Its output was always lower than that of bajra or cotton. Maize was either fourth or fifth in terms of its share in area and had a slightly

Table 20. First five crops ranked in order of shares in output and area in Punjab, 1909-1954
(in percentages of total crops)

			Output			
1909-1912	Wheat 42.8	Gram 26.9	Maize 6.7	Sugarcane 6.1	Bajra 4.9	Total 87.4
1919-1922	Wheat 40.4	Gram 19.1	Sugarcane 9.4	Maize 9.2	Bajra 6.1	84.2
1929-1932	Wheat 45.3	Gram 18.5	Maize 8.8	Sugarcane 6.5	Bajra 6.3	85.4
1939-1942	Wheat 46.4	Gram 13.1	Maize 9.8	Sugarcane 9.6	Cotton 6.7	85.6
1951-1954	Wheat 36.5	Gram 18.3	Sugarcane 16.8	Maize 8.4	Bajra 6.7	86.7
			Area			
1909-1912	Wheat 31.2	Gram 28.4	Bajra 10.9	Barley 8.2	Maize 6.8	Total 85.5
1919-1922	Wheat 27.9	Gram 24.1	Bajra 16.1	Maize 7.6	Barley 7.0	82.7
1929-1932	Wheat 30.4	Gram 24.5	Bajra 16.1	Maize 7.3	Cotton(desi) 4.1	82.4
1939-1942	Wheat 30.7	Bajra 22.3	Gram 17.1	Maize 8.1	Cotton(desi) 5.9	84.1
1951-1954	Wheat 27.7	Gram 22.4	Bajra 10.0	Maize 7.2	Jowar 6.2	73.5

better position in terms of output, but only in some years. The only other crop that figured among the first five was cotton, but only in the years 1939-1942. In terms of area, foodgrains were important crops cultivated in Punjab. As far as output was concerned, sugarcane was an important cash crop, ranking fairly high in the rank order of output.

4. Pattern of land use

It has already been noted that change in acreage was a factor of comparatively negligible importance in contributing to variations in output over the period 1909-1912 to 1951-1954. The data on land utilization presented in table 21 show a narrow range of fluctuations in the proportion of net sown area to total arable land at the state level; it was between 71 and 75 per cent during 1911-1951. There are, however, significant interdistrict variations. In 1909-1912, the proportion of net sown area to arable land exceeded 80 per cent in several districts, but was comparatively low in Hissar, Karnal, Kangra and to a certain extent Hoshiarpur, mainly because a good fraction of the culturable waste had not been brought under cultivation. Current fallows, however, formed a large part of the unused land in Hissar. During 1919-1922, there was a significant fall in current fallows in Hissar, so that the proportion of net sown area to arable land increased, although the trend in every other district was one of relative decline. On the other hand, the average for Hissar for the years 1929-1932 showed an increase in the proportion of net sown area to total arable land. The years 1939-1942, again, saw a relative decline in acreage under crops in a large number of districts. In Gurgaon, Ambala, Hoshiarpur and Gurdaspur, however, the proportions of cropped area to arable land showed comparatively stationary levels.

It may be pertinent to describe briefly the changes in gross sown area during the period under study. The relevant data are presented in table 22. At the state level, the decades 1911-1921 and 1931-1941 saw a decline in gross sown area of 8 per cent and 4 per cent respectively, while, in the other two decades, there was an increase in 1921-1931 of 11.6 per cent and a small increase of 2.5 per cent in the last period. Interdistrict variations, however, were quite striking in a few cases. In the decade 1911-1921, the decline in Hissar and Karnal was 16 per cent and 11 per cent respectively, while Rohtak showed a nominal increase in gross sown area of 0.8 per cent. In the following decade, Hissar, Gurgaon and Rohtak showed marked increases in gross sown area of 25 per cent, 18 per cent and 13 per

Table 21. Pattern of land utilization in the districts of Punjab, 1909-1912 to 1939-1942: percentage distribution of arable land by land use

District	1909-1912			1919-1922		
	Culturable waste	Current fallows	Net sown area	Culturable waste	Current fallows	Net sown area
Hissar	14.8	18.9	66.3	16.6	13.1	70.3
Rohtak	10.7	6.6	82.7	13.3	8.6	78.1
Gurgaon	9.2	9.5	81.3	14.1	13.2	72.7
Karnal	34.6	7.6	57.8	34.7	13.4	51.9
Ambala	13.5	5.0	81.4	15.6	5.3	79.1
Kangra	31.4	7.6	60.9	35.5	9.3	55.2
Hoshiarpur	21.3	4.3	74.4	26.7	3.1	70.2
Jullundur	10.3	4.2	85.5	12.2	8.0	79.8
Ludhiana	9.9	4.6	85.5	10.5	9.6	79.8
Ferozepur	7.4	10.1	82.6	8.2	17.1	74.8
Amritsar	11.8	6.6	81.6	13.5	6.1	80.4
Gurdaspur	12.5	5.3	82.2	12.5	5.5	82.0
Total	15.6	9.7	74.8	17.7	10.7	71.3

District	1929-1932			1939-1942		
	Culturable waste	Current fallows	Net sown area	Culturable waste	Current fallows	Net sown area
Hissar	13.9	12.7	73.4	15.2	22.9	61.9
Rohtak	13.7	6.7	79.6	14.6	9.8	75.6
Gurgaon	13.1	7.3	79.6	13.8	6.7	79.5
Karnal	36.7	11.3	52.0	36.1	14.3	49.6
Ambala	13.8	3.6	82.6	13.2	3.9	82.9
Kangra	35.9	8.5	55.6	37.4	9.2	53.4
Hoshiarpur	24.6	2.7	72.7	24.7	2.5	72.8
Jullundur	10.2	3.1	86.7	9.7	7.3	83.0
Ludhiana	8.9	4.2	86.9	9.1	7.6	83.3
Ferozepur	7.1	11.2	81.7	10.4	12.1	77.5
Amritsar	12.3	3.6	84.1	14.3	4.6	8.1
Gurdaspur	10.5	3.3	86.2	9.5	3.0	87.5
Total	16.5	8.1	75.4	17.4	11.3	71.3

Source: Statistics on land utilization which mainly give areas of land put to different uses are almost continuously available since 1884, although the geographical coverage of these statistics and their scope have been gradually expanding. Prior to Independence in 1947, they were published by the Department of Commercial Intelligence and Statistics. Since Independence, they have been published in the annual ***Indian Agricultural Statistics*** issued by the Directorate of Economics and Statistics, Ministry of Food and Agriculture, Government of India.

cent respectively. At the other extreme, Kangra showed a nominal decline of 0.2 per cent. The notable feature in the following decade was the fall of 15 per cent in gross sown area in the district of Hissar. Finally, in the last period, i.e. 1939-1942 to 1951-1954, Karnal, Amritsar and Rohtak recorded increases of 18 to 24 per cent compared with the state average of a more 2.5 per cent. In contrast, Gurdaspur, Jullundur and Ludhiana recorded declines as large as 34 per cent, 16 per cent and 10 per cent respectively.

Data on intensity of land use presented in table 23 show marginal variations in the ratio of gross sown area to net sown area over the period of study. At the state level, the ratio declined from 120 per

Table 22. Percentage change in gross area sown in the 12 districts of Punjab, 1909-1954

District	1909-1912 to 1919-1922	1919-1922 to 1929-1932	1929-1932 to 1939-1942	1939-1942 to 1951-1954
Hissar	-15.63	25.39	-15.04	11.6
Rohtak	0.78	13.21	-6.76	18.3
Gurgaon	-1.25	18.53	-0.67	5.1
Karnal	-11.16	8.14	-3.71	23.9
Ambala	-9.33	7.01	0.31	-3.0
Kangra	-3.54	-0.24	-2.02	7.1
Hoshiarpur	-3.31	5.14	0.03	-6.4
Jullundur	-7.42	8.52	-0.40	-16.3
Ludhiana	-3.84	10.04	-0.78	-10.4
Ferozepur	-8.88	8.84	-3.33	-0.6
Amritsar	-9.09	8.50	-1.29	20.7
Gurdaspur	-3.22	10.48	4.73	-34.3
Total	-7.89	11.64	-3.93	2.5

Table 23. Intensity of land use[a] in the 12 districts of Punjab, 1909-1942

District	1909-1912	1919-1922	1929-1932	1939-1942
Hissar	110.20	103.22	105.19	106.07
Rohtak	124.68	107.39	119.49	117.27
Gurgaon	125.24	107.89	116.98	116.09
Karnal	116.08	111.47	119.76	120.66
Ambala	125.65	116.68	119.47	119.50
Kangra	152.81	155.07	154.21	156.85
Hoshiarpur	133.21	129.14	130.47	128.94
Jullundur	127.10	127.26	127.17	132.95
Ludhiana	110.47	116.26	117.48	121.69
Ferozepur	110.16	109.63	110.51	111.74
Amritsar	125.87	128.99	133.34	134.78
Gurdaspur	117.98	116.71	121.48	124.20
Total	119.77	116.85	118.45	119.84

[a] Ratio of net area sown to gross area sown.

Table 24. Proportion of net area irrigated[a] to net area sown in the 12 districts of Punjab, 1909-1942

District	1909-1912	1919-1922	1929-1932	1939-1942
Hissar	11.29	12.68	12.77	17.10
Rohtak	13.47	26.45	34.41	45.65
Gurgaon	13.22	16.88	17.82	19.22
Karnal	23.58	40.03	46.38	58.90
Ambala	3.34	6.87	6.59	9.11
Kangra	33.60	36.55	35.38	37.60
Hoshiarpur	7.50	13.55	12.91	15.07
Jullundur	51.88	66.65	62.93	72.26
Ludhiana	26.51	44.49	50.59	65.19
Ferozepur	35.07	51.06	58.79	68.74
Amritsar	71.05	90.75	98.86	99.86
Gurdaspur	23.72	33.26	34.23	39.50
Total	24.76	35.17	37.27	44.27

Sources: Statistics on area irrigated from different sources and the total area of crops irrigated are published in the annual *Indian Agricultural Statistics.*

[a] Refers to area of land classified according to the sources of irrigation.

cent in 1909-1912 to 117 per cent in 1919-1922; thereafter, it increased to reach the original level by 1939-1942. However, it declined again by 117 per cent in 1951-1954.

At the district level, the intensity of cropping varied within a wide range, from 110 per cent in Hissar, Ludhiana and Ferozepur to levels as high as 133 per cent in Hoshiarpur and 153 per cent in Kangra. There were marked fluctuations between 1901-1912 to 1939-1942 in most of the districts. Thus, there was a long-term declining trend in the intensity of cropping in Hissar and Gurgaon and to a lesser extent in Ambala and Hoshiarpur. On the other hand, in Karnal, Kangra, Ludhiana, and Amritsar, there was a tendency towards higher intensity of cropping. Other districts showed some variations, but these were more or less around the same level.

As may be noted from table 24, the most remarkable feature of agricultural development in Punjab is a steady increase in the proportion of irrigated area to net sown area, from about 25 per cent to over 40 per cent between 1911 and 1951. Again, the extent of irrigated area showed significant variations from one district to the other in 1901-1912, touching a low of 3.3 per cent in Ambala and recording a high of 71 per cent in Amritsar. It may be noted that there was an uninterrupted increase in the proportion of net area irrigated to net area sown until 1939-1942 in all the districts. The range of interdistrict variations became wider in the years around 1941: the lowest proportion of irrigated area recorded by Ambala was only 9 per cent as against almost 100 per cent in Amritsar. Karnal, Jullundur, Ludhiana and Ferozepur also recorded high proportions ranging from 59 to 72 per cent. Similar trends were observed at both the state and the district levels in respect of the proportion of gross area irrigated to gross area sown, although the magnitudes involved here are somewhat lower.

B. ORISSA

As indicated in the section on population growth in Orissa for the period 1901-1951, the State of Orissa was formed by the merger of a number of princely states and the districts which were part of British India. There are no recorded agricultural statistics for the former princely states. Statistics on land utilization could be obtained only for the four British districts (Cuttack, Balasore, Puri and Sambalpur) from Agricultural Statistics volumes published by the Government of India. These volumes, however, do not contain any data on agricultural output. Production data were available from the Season and Crop Reports for Bihar and Orissa, but only for the years since 1930. Season and Crop Reports for the period before 1930 could not be found. Unfortunately, therefore, the analysis for 1901-1951 is very restricted in terms of space as well as time coverage.

Table 25 gives the growth rates in output and area and changes in output per hectare during 1929-1932 to 1939-1942 and 1939-1942 to 1951-1954. Output data relate to only eight crops: rice, wheat, gram, linseed, rape and mustard, sugarcane, jute and tobacco. The geometrical mean of the average of prices in 1952-1954 and 1959-1961 has been used for converting production into comparable money terms. It may be noted that during the decade 1931-1941 there was a decline in output in Cuttack, Balasore and Puri by 1.7 per cent, 0.7 per cent and 5.1 per cent respectively. Sambalpur, however, showed a marginal increase of 0.9 per cent per annum during this period. In Puri, the heavy decline in agricultural production was a result of a decline in both area and output per hectare of 1.4 per cent and 3.8 per cent per annum. In Cuttack and Balasore, on the other hand, the fall in output was significant but had occurred despite an increase in area under crops. This implies a heavy drop in yields. Similarly, in Sambalpur the cropped area increased by 3 per cent per annum, but the annual increase in output remained marginal on account of a significant decline in productivity.

In the next decade, 1941-1951, Cuttack and Balasore again recorded small decreases in total output due to continued decline in yields, although the cropped area increased by 1.5 and 1.4 per cent respectively. Puri recorded a perceptible increase of 3.7 per cent per annum in output, but this was largely due to a recovery of the area under cultivation which was lost due to cyclones and floods in the preceding decade. The increase was entirely due to an increase in area under crops, while productivity actually declined. Sambalpur showed a nominal increase of 0.2 per cent per annum in total output. The increase in area cultivated (1.3 per cent per annum) was largely neutralized by the fall in productivity.

Thus, while area under the crops recorded, on the whole, some increase during the period 1931-1951, productivity showed a persistent decline. In 1931, Cuttack recorded a fairly high level of output per hectare in money terms (Rs 68 per hectare), but by 1951 this had declined to Rs 43 per hectare. Similar trends were noted in Balasore, Puri and

Table 25. Average annual rate of growth in output, area and productivity in agriculture in four districts of Orissa, 1929-1932 to 1951-1954

District	Output	Area	Productivity	Output per hectare (in Rs)		Output	Area	Productivity	Output per hectare (in Rs)	
				Base	Final				Base	Final
	1929-1932 to 1939-1942					1939-1942 to 1951-1954				
Cuttack	-1.7	0.9	-2.7	415.1	318.8	-0.2	1.5	-1.6	318.8	261.9
Balasore	-0.7	1.6	-2.2	343.5	274.3	-0.6	1.4	-2.1	274.3	217.4
Puri	-5.1	-1.4	-3.8	373.1	254.5	3.7	4.0	-0.4	254.5	249.6
Sambalpur	0.9	3.0	-2.1	355.8	286.6	0.2	1.3	-1.0	286.6	257.0

Note: Data on output for 1951-1954 in this table cover only eight crops so as to retain comparability with that in 1939-1942 and must be distinguished from the production data for 1951-1954 used in the section dealing with the period 1951-1954 to 1960-1963 where its coverage is substantially enhanced. The difference, however, is not substantive since rice alone accounts for more than 90 per cent of the total production.

Sambalpur where output per hectare also declined. The relative ranking of different districts in order of productivity remained practically unaltered.

1. Shifts in crop-pattern

The respective shares of different crops in output and area are presented in table 26. It clearly shows the rice-dominated subsistence type of agriculture in all four districts. In fact, rice is the only crop of significance. In Cuttack, however, tobacco contributed about 12 per cent of total output around 1931. Since it is a very high-value crop, it did not figure as a crop of any importance in terms of its share in area. Its share of area and output, however, progressively declined in the years around 1941 and 1951. Tobacco was replaced in Cuttack by sugarcane and jute which are two other high-value commercial crops. Therefore, one cannot attribute any significant part of the decline in overall productivity in Cuttack to a deterioration in the crop pattern. In fact, sugarcane, jute and tobacco together accounted for over 20 per cent of output and 6 per cent of area in 1951-1954, as against 13 per cent and 3 per cent, respectively, in 1929-1932. About 7 per cent of Balasore's total output in 1951-1954 was jute, while Puri and Sambalpur reported 4 per cent of output from sugarcane. However, rice continued to claim more than 90 per cent of output and area in Bala-

Table 26. Percentage shares of crops in output and area in four districts in Orissa, 1929-1932 to 1951-1954

District	Rice	Tobacco	Jute	Sugar-cane	Total of four crops	Rice	Tobacco	Jute	Sugar-cane	Total of four crops	Rice	Tobacco	Jute	Sugar-cane	Total of four crops
			1929-1932 Output					1930-1942 Output					1951-1954 Output		
Cuttack	84.9	11.7	2.4	0.7	99.7	84.3	6.3	4.5	3.5	98.6	78.1	1.2	16.2	3.1	98.6
Balasore	97.7	0.4	0.8	0.5	99.4	97.5	0.7	0.6	1.1	99.9	91.8	-	7.1	0.6	99.5
Puri	98.5	0.4	-	0.8	99.7	94.8	0.3	0.3	4.2	99.6	94.7	0.3	0.3	4.1	99.4
Sambalpur	96.1	2.0	-	1.7	99.8	89.8	3.3	-	5.4	98.5	94.3	1.1	0.1	3.9	99.4
			Area					Area					Area		
Cuttack	96.2	0.9	1.5	0.3	98.9	95.9	0.4	1.9	0.6	98.8	92.6	0.1	5.4	0.7	98.8
Balasore	98.6	...	0.3	0.2	99.1	99.4	...	0.3	0.1	99.8	96.8	-	3.0	0.1	99.9
Puri	99.2	...	-	0.4	99.6	98.7	...	0.1	0.6	99.4	98.5	....	0.1	0.6	99.2
Sambalpur	98.8	0.1	-	0.8	99.7	97.8	0.2	-	0.7	98.7	98.7	0.1	...	0.6	99.4

sore, Puri and Sambalpur during the entire period from 1929-1932 to 1951-1954. On the other hand, in Cuttack, rice output as well as area under rice decreased during this period. In all four districts, output of rice decreased more than the area under rice cultivation. Thus, it seems that the decline in yield is the major factor in the fall in agricultural output in all the four districts between 1931 and 1951.

Table 27. Pattern of land utilization in four districts of Orissa, 1911-1951

District	1911	1921	1931	1941	1951
Net sown area					
Cuttack	72.4	75.5	71.6	63.6	68.7
Balasore	88.3	82.5	76.5	77.3	82.5
Puri	77.2	66.4	68.7	46.1	69.1
Sambalpur	51.1	49.4	47.5	61.9	48.3
Fallows					
Cuttack	17.1	14.0	17.9	16.9	18.4
Balasore	6.3	12.5	14.2	6.6	5.8
Puri	5.8	9.7	7.4	30.1	5.0
Sambalpur	10.0	12.1	36.3	14.3	5.8
Cultivable waste					
Cuttack	10.5	10.5	10.4	19.5	12.9
Balasore	5.4	5.4	9.3	16.1	11.7
Puri	17.0	23.8	23.9	23.8	25.9
Sambalpur	39.1	38.5	36.2	23.8	45.0

2. Pattern of land use

While output data were available only since 1931, land utilization statistics could be obtained for the period beginning 1911. Table 27 shows that 88 per cent of Balasore's arable land was already under cultivation in 1911. The proportion under cultivation was 77 per cent in Puri and 72 per cent in Cuttack. In Sambalpur, however, it was just a little over one half; about 40 per cent of arable land was cultivable wasteland and 10 per cent was fallow. The proportion of net sown area to arable land does not show any uniform trend over time. In Balasore, net sown area declined to 82 per cent in 1921, and dropped further to 77 per cent in 1931-1941 but rose to the 1921 level again in 1951. In Cuttack, it remained nearly stationary, at about 75 per cent, till 1931, but dropped to 64 per cent in 1941 and rose to 69 per cent by 1951. In Puri, the percentage of net sown area declined sharply from 69 per cent in 1931 to 46 per cent in 1941 but regained its 1931 level in 1951. Sambalpur showed marked fluctuations, with a marginal decline from about half of arable land under cultivation in 1911 and 1921 to 47 per cent in 1931, 62 per cent in 1941 and 48 per cent in 1951. The figures, however, can be taken to indicate broadly the magnitude of change rather than precise changes since the system of reporting land use during this period was not very accurate.

Table 28. Percentage change in net sown area in four districts of Orissa, 1911-1951

District	1911-1921	1921-1931	1931-1941	1941-1951
Cuttack	4.3	-5.2	-2.5	7.5
Balasore	-6.5	-4.5	9.0	6.4
Puri	0.1	3.2	-31.0	37.0
Sambalpur	-3.3	2.9	37.0	-21.0

As may be noted from table 28 that the four districts do not show any consistent trend in net sown area. Between 1911 and 1921, Balasore and Sambalpur suffered losses of 6.5 per cent and 3.3 per cent; Cuttack recorded a gain of about 4 per cent, and Puri remained nearly stationary. In the next decade, Balasore registered a further decline of 4.5 per cent, but Cuttack also showed a significant decline. Puri and Sambalpur registered marginal gains of around 3 per cent each. In 1931-1941, Balasore and Sambalpur showed an increase in net sown area, while the changes in Cuttack and Puri were in the opposite direction. The changes were striking in Puri and Sambalpur: a loss of 31 per cent in the former and a gain of 37 per cent in the latter. The position of these two districts was reversed in 1941-1951: Puri recorded an increase in net sown area of 37 per cent and Sambalpur a loss of 21 per cent. Balasore and Cuttack recorded minor gains of 6.4 and 7.5 per cent respectively in the decade.

The changes in area under crops considered in table 25 broadly correspond to the trends in net sown area in the decades 1931-1941 and 1941-1951 just noted. What is more important to note is that, on the whole, the increase in area under crops was greater than was the case with regard to net sown area, particularly in 1941-1951. In fact, during this decade, Sambalpur recorded an annual increase of 1.3 per cent in the area under crops even though net sown area showed a decline of 21 per cent. This may partly be due to reporting bias, but in part, the tendency may indicate an increase in the area under major crops and/or double cropping.

Section II – CHANGES IN AGRICULTURE: 1951-1971

A. PUNJAB

1. Aggregate growth rates

Analysis of growth rates in agriculture during the two decades commencing in 1951 is presented in this section. The trends in this period reflect the influence of state policies directed toward agricultural development through land reclamation, irrigation, extension services and the supply of new inputs. The most notable results of these policies were the completion of the Bhakra Nangal dam in the 1950s and the introduction of high-yielding varieties of seeds in the 1960s. Another event of vital importance was the bifurcation of the state of Punjab in 1966 into the two independent states of Punjab and Haryana.

In table 29 are given the annual (compound) rates of growth in agriculture and change in output per hectare in the districts of composite Punjab arranged in descending order of growth of output. At the district level, there has been a reshuffling of boundaries in some cases in each of the two decades. Adjustments have been made for these changes so that the data for each district relate to its 1961 boundaries.

The acceleration in agricultural growth in the period 1951-1971 is noteworthy. Total agricultural output increased by 5.4 per cent per annum between 1951-1954 and 1960-1963 and by 6.7 per cent between 1960-1963 and 1968-1971. Computations for the two reorganized states show that the annual growth of output in the new Punjab was a little over 4 per cent in the 1950s; it almost doubled to 8 per cent in the succeeding period. Haryana, on the other hand, showed a striking increase of 7.5 per cent per annum in the 1950s, but the increase in output declined to around 4 per cent in the 1960s.

The districts were classified into "high" and "low" growth districts on the basis of their respective rates of output relative to the state average. Growth rates of output show a striking range, varying from 5.2 to 11.7 per cent in the "high" group and from 0.8 to 4.6 per cent in the "low" group in the period 1951-1954 to1960-1963. The districts of Haryana and Punjab show a marked contrast. Among the six districts of Haryana, the lowest and the highest growth rates in the period 1951-1954 to 1960-1963 were 4.6 and 10.9 per cent respectively. Except for Patiala, with a growth rate of 11.7 per cent, the districts of Punjab showed relatively low rates.

Increase in area was a more important factor than increase in productivity in contributing to the growth of output at both the state and the district levels. The four "high" output growth districts also recorded relatively large gains in area. Patiala, Hissar and Karnal showed a phenomenal gain in area of 8.8, 5.6 and 5.1 per cent respectively, mainly due to irrigation facilities made available by the Bhakra project.

Output per hectare in composite Punjab was Rs 311 in 1951-1954 and Rs 376 in 1960-1963. At the district level, it showed a considerable range; the minimum noted in the initial period was Rs 91 in Mahendragarh, while the maximum of Rs 563 was estimated for Kapurthala. Patiala, Karnal, Bhatinda and Sangrur were the only "high" output districts which also showed higher output per hectare in rupees than the average for the state in the base period, though only marginally so. All other districts in the "high" group had relatively low output per hectare in the base period. On the other hand, relatively "high" levels of output per hectare were observed in the base period in most of the districts with "low" rates of output growth. It is interesting to note that there was an inverse relationship between initial levels of output per hectare and annual rates of growth of output per acre in the districts during the period 1951-1954 to 1960-1963; the coefficient of correlation was as high as -87, which suggests that those districts with initially low rupee output per acre made the best use of their productive potential over the period. Consequently, the interdistrict range in productivity became narrower and the coefficient of variation fell from 33.2 per cent in the base period to 23.9 per cent in the final period.

It is striking to note that, in the initial period, increase in productivity in most of the districts in composite Punjab lay within a narrow range of 2 to 3 per cent, irrespective of their ranks in order of increase in over-all output. The only major exceptions were Hissar and Mahendragarh in the "high" category which showed productivity gains of 5 and 7 per cent per annum respectively. In the "low" group, Amritsar recorded an increase of less than 1 per cent, while Kapurthala showed an actual decline in productivity of over 3 per cent per annum.

Significant interdistrict variations in productivity were also observed in the period 1960-1963 to 1968-1971. At the state level, Haryana's growth rate in agricultural output fell, whereas it increased in the case of reorganized Punjab. Karnal was the only district in Haryana which recorded an increase in output of 7.5 per cent per annum, slightly exceeding the average growth rate for composite Punjab. Karnal has continued to enjoy a high rate of growth since 1951-

1954. All other districts of Haryana showed significantly lower rates. Gurgaon and Rohtak (in Haryana) sustained their records of the preceding decade, the annual increases in the years 1960-1963 to 1968-1971 being 5.6 and 4.4 per cent respectively. Ambala recorded a decline from 4.6 per cent in the 1950s to 3.2 per cent in the recent period; Hissar and Mahendragarh experienced a dramatic decline from growth rates of around 11 per cent in the 1950s to less than 4 per cent in the 1960s.

In new Punjab, Ludhiana had an all-time high annual output growth rate of 12.3 per cent during 1960-1963 to 1968-1971. It was followed by Kapurthala and Amritsar, with growth rates of 10.2 and 9.5 per cent respectively. The performances in Gurdaspur, Bhatinda, Jullundur and Karnal were also impressive, with rates between 7.5 and 8.5 per cent. Hoshiarpur, Ferozepur, Patiala and Sangrur also showed 6 to 7 per cent rates of annual growth, which were in themselves quite impressive but were significantly lower than the phenomenal rates recorded by other districts. Patiala's rate fell to a little less than half its 1951-1954 to 1960-1963 rate.

As indicated in table 29, it is striking to note that, with the exception of Karnal, Bhatinda and Sangrur, the districts which appeared in the "high" output growth group in 1960-1963 to 1968-1971 were in the "low" output growth category in the preceding period. In fact, Kapurthala, with second rank in the latter period, was lowest in output growth in the earlier period. In new Punjab, with the exception of Patiala (whose output growth was lower in 1960-1963 to 1968-1971 than it had been in the preceding period), all the other districts experienced very impressive growth in the rate of agricultural output in the late 1960s. An important feature of agricultural growth in Punjab in the years 1960-1963 to 1968-1971 was the diminished role of increase in area under crops. Taking composite Punjab as a whole, cropped area increased by only 1.2 per cent per annum, while crop output recorded an increase of 6.7 per cent per annum.

The districts of Haryana experienced a very low increase in area. During the 1950s, the average increase in area was about 3.4 per cent, whereas, during the 1960s, it was a mere 0.6 per cent per annum. Ambala and Karnal were the only districts in Haryana which recorded a perceptible gain in acreage of 2.2 per cent and 1.8 per cent per annum respectively. Cropped area in the other districts of Haryana either remained stationary or showed a nominal decline. In new Punjab, on the other hand, a large number of districts registered increases in cropped area, both in absolute terms and by comparison with the preceding period. Patiala, however, which had recorded a phenomenal expansion of 8.8 per cent per annum in the 1950s showed a nominal increase of 0.6 per cent per annum in the 1960s.

It may be noted, however, that, while area increases accounted for a relatively minor part of the growth of agricultural output in the 1960s, there was a positive association between area and output. Six out of the eight districts in the "high" output growth group also reported higher rates of increase in the area under cultivation. Many of the districts in the "low" output growth group maintained stationary acreage; two of them actually experienced an absolute, although small, decline.

The dominant role of increase in output per hectare during the 1960s was evident in all the districts, with the sole exception of Ambala. This was true of composite Punjab as well as of new Punjab and Haryana. In relative terms, however, the increase in output was more pronounced in Haryana. In new Punjab, Jullundur was the only district in the "high" output growth group which recorded a relatively smaller than average gain in productivity, although its absolute rate of increase was 4.5 per cent per annum and exceeded the rate of its acreage extension. Gurgaon in the "low" growth group showed a relatively high productivity gain. But it is worth noting that, except for Ambala, the rates of increase in productivity in other districts of the "low" group were also fairly impressive; they ranged from 3.2 to 5.0 per cent.

Moreover, while productivity was almost stagnant until 1960-1963 in the districts which had attained a relatively high level of prosperity as far back as the 1940s, it has registered a marked acceleration in recent years. Kapurthala, Amritsar, Gurdaspur, Jullundur and Ferozepur, for example, showed productivity gains of 5 to 7 per cent per annum between 1960-1963 and 1968-1971. In the earlier period, an inverse relationship was observed between the base level of productivity and the annual growth rate of output per hectare in these districts. The relationship changed in the 1960s. Haryana had a relatively lower rupee output per hectare than new Punjab in the period 1960-1963 (about Rs 297 per hectare as against Rs 420), but it has also experienced a relatively slower annual growth of output per hectare in recent years than new Punjab. At the district level, the trends are very uneven. Almost equally high rates of increase in productivity (5.7 per cent per annum) were observed in Karnal and Gurgaon, although, in the years 1960-1963, Karnal had a rupee output per hectare of Rs 415 whereas it was Rs 259 in Gurgaon.

Table 29. Average annual growth rates in output, area and productivity in the districts of Punjab, 1951-1971

District		Output	Area	Productivity	Output per hectare (in Rs)	
					Base	Final
			1951-1954 to 1960-1963			
Hight output growth districts						
Patiala	(P)	11.7	8.8 (High)	2.7 (High)	375.6	474.4
Mahendragarh	(H)	10.9	3.4 (High)	7.2 (High)	91.4	170.5
Hissar	(H)	10.9	5.6 (High)	5.0 (High)	180.4	279.2
Karnal	(H)	7.5	5.1 (High)	2.3 (High)	331.1	415.1
Gurgaon	(H)	5.6	2.7 (Low)	2.8 (High)	202.6	259.5
Bhatinda	(P)	5.3	2.7 (Low)	2.5 (High)	296.5	370.7
Sangrur	(P)	5.2	2.9 (Low)	2.3 (High)	311.4	383.0
Composite Punjab		5.3	3.2	2.1	311.4	375.6
Low output growth districts						
Ambala	(H)	4.6	1.7 (Low)	2.9 (High)	328.7	415.1
Rohtak	(H)	4.6	2.1 (Low)	2.5 (High)	301.5	383.0
Ludhiana	(P)	4.3	1.8 (Low)	2.4 (High)	442.3	546.1
Jullundur	(P)	4.2	2.8 (Low)	1.3 (Low)	514.0	580.7
Hoshiarpur	(P)	3.8	0.8 (Low)	3.0 (High)	442.3	514.0
Ferozepur	(P)	3.5	1.5 (Low)	1.9 (Low)	365.7	434.9
Gurdaspur	(P)	2.2	0.7 (Low)	1.5 (Low)	350.9	402.8
Amritsar	(P)	1.8	0.9 (Low)	0.9 (Low)	405.3	437.4
Kapurthala	(P)	0.8	4.1 (Low)	-3.1 (Low)	563.4	425.0
			1960-1963 to 1968-1971			
High output growth districts						
Ludhiana	(P)	12.3	5.7 (High)	6.2 (High)	546.1	884.7
Kapurthala	(P)	10.2	3.2 (High)	6.7 (High)	425.0	716.6
Amritsar	(P)	9.5	2.3 (High)	7.1 (High)	437.4	756.2
Gurdaspur	(P)	8.5	3.0 (High)	5.4 (High)	402.8	612.8
Bhatinda	(P)	8.1	1.3 (High)	6.7 (High)	370.7	622.7
Jullundur	(P)	7.7	3.1 (High)	4.5 (Low)	580.7	822.9
Karnal	(H)	7.5	1.8 (High)	5.6 (High)	415.1	645.0
Sangrur	(P)	6.9	1.7 (High)	5.1 (Low)	383.0	568.4
Composite Punjab		6.7	1.2	5.4	375.6	573.3
Low output growth districts						
Hoshiarpur	(P)	6.4	3.0 (High)	3.2 (Low)	397.8	514.0
Ferozepur	(P)	6.2	1.4 (High)	4.8 (Low)	434.9	632.6
Patiala	(P)	5.7	0.6 (Low)	5.0 (Low)	474.4	699.3
Gurgaon	(H)	5.6	-0.1 (Low)	5.7 (High)	259.5	402.8
Rohtak	(H)	4.4	0.2 (Low)	4.2 (Low)	383.0	531.3
Mahendragarh	(H)	3.9	0.0 (Low)	3.9 (Low)	170.5	229.8
Hissar	(H)	3.8	-0.4 (Low)	4.2 (Low)	279.2	388.0
Ambala	(H)	3.2	2.2 (High)	1.0 (Low)	415.1	449.7

Sources: (1) Government of India, Directorate of Economics and Statistics, ***Estimates of Area and Production of Principal Crops in India*** for relevant years.
(2) Government of India, Directorate of Economics and Statistics, ***Indian Agricultural Statistics*** for relevant years.

Note: (P) denotes districts in reorganized Punjab State after the 1966 bifurcation
(H) denotes districts in Haryana State after the 1966 bifurcation

A more remarkable fact, however, was the progress of the already developed districts with relatively high levels of output per hectare in the base years. This may be attributed to the technological breakthrough following the adoption of the new seed-water-fertilizer package of inputs. The trend, however, was not confined to agriculturally prosperous districts.

2. Rates of growth of different crops

In this section, changes in the crop pattern will be examined to see how far they reflect changes in the pattern of growth of aggregate output. The relevant data are presented in table I of annex III. The major crops in composite Punjab were wheat, gram, rice, maize, bajra, sugarcane, cotton and oilseeds. The variations in crop-wise growth rates for 1951-1954 to 1960-1963 are shown in the first part of the table and changes in the recent period in the second part. Wheat is an important food crop in the state, and in the early period the increase in the output of wheat roughly corresponded with the increase in aggregate output of foodgrains in the state. Extension of area was a more significant factor than productivity in contributing to the increase in production of wheat in the 1950s. The output of rice showed a significantly higher rate of increase (about 10 per cent per annum), largely due to the expansion of area under this crop. It is striking to note that inferior or coarse cereals, such as bajra and barley, recorded an absolute decline in output as well as in area during the 1950s. The output of jowar also declined, although the area remained stable. The output of maize, on the other hand, showed an annual increase of about 3 per cent; the extension of area under this crop also increased significantly. Productivity, however, declined at more than 1 per cent per annum. Gram was another important crop in the state which showed an increase in output roughly equal to the change in aggregate output in foodgrains. Like the inferior cereals, the increase in the output of gram was entirely due to an increase in area; productivity showed a small decline during the period. Pulses did not record any significant increase in output or productivity in this period. Of all the food crops, potatoes showed the maximum increase: the annual rise in output was 12.6 per cent, mainly due to a gain in area, but productivity also increased by more than 4 per cent. All food crops together recorded an increase in output which was lower than that in aggregate output. Also, increase in area was a more important factor in the growth of output of foodgrains than was increase in productivity.

Non-food crops recorded comparatively faster increases in output, area and productivity than did food crops. Output of sugarcane, which is an important cash crop in the state, increased by 6.7 per cent, largely due to extension of area. Oilseeds and cotton, the two other important commercial or cash crops, showed an output increase of about 9 per cent each. Other commercial crops, such as tobacco, chillies and tea, which are of relatively minor importance at the state level, showed comparatively lower rates of growth. Tobacco output, in fact, declined.

Interdistrict variations in the growth of food output showed nearly the same pattern as the increase in aggregate output. For example, Hissar, Karnal, Patiala and Mahendragarh recorded very high rates of growth in the output of food, as well as of aggregate output. In eight districts, agricultural growth rates ranged between 3 and 4.5 per cent. Ferozepur and Amritsar had low annual increases of only 2 per cent, whereas Gurdaspur and Kapurthala had markedly low rates of increase in the output of food: 1.6 and -0.1 per cent respectively. In fact, Kapurthala was the only district which showed an actual decline in food production.

As at the state level, the output of non-food crops during 1951-1961 recorded a relatively larger increase than food output in most districts. The two conspicuous exceptions were Amritsar and Hoshiarpur. It is also noteworthy that productivity generally increased faster in non-food than in food crops. However, increases in the area under non-food crops was also fairly striking in the "high" growth districts of Hissar, Patiala and Bhatinda. Above-average increases in the area under non-food crops were also observed in Rohtak and Kapurthala, even though they belong to the "low" growth group of districts.

With respect to foodgrains, high rates of growth as well as large interdistrict variations were observed in the output of some individual crops. The growth rate of rice output was as high as 20 per cent or more, not only in the "high" growth districts of Hissar, Patiala, Bhatinda and Sangrur, but also in the relatively "low" growth districts of Jullundur, Ludhiana and Kapurthala. Output of rice showed an increase of betwen 10 and 15 per cent in Rohtak, Karnal, Ambala and Hoshiarpur. As in the case of food crops, increase in area made a larger contribution than productivity gains in most districts with the exception of Ambala and Ferozepur. Wheat recorded a notable increase in output of over 16 per cent only in Hissar. In all other districts, the rate of expansion of wheat nearly corresponded to that of aggregate output. Barley generally showed a nominal increase or even an absolute decline in most of the districts; Karnal and Patiala were the only districts with a substantial expansion of area under this crop. Similar trends were observed in jowar and bajra. In Patiala, bajra output increased at the rate of 18 per cent. Output of maize increased at a phenomenal rate of 25 per cent per annum in Hissar and 13 per cent in Bhatinda, in both cases almost wholly because of expansion of area. Rohtak, Gurgaon and Ambala were other districts where maize recorded a significantly high increase. However, productivity of this crop showed a general decline. Similarly, a striking increase in the output of gram was observed only in Hissar, Gurgaon, Karnal, Mahendragarh and Patiala. In most other districts, maize and gram showed a small increase or an actual decline. Here again, increase in area was the major factor in the rapid growth of maize and gram.

Among the non-food crops, sugarcane output expanded rapidly in most of the districts with "high" rates of agricultural growth. Ambala and Gurdaspur were the only other districts which reported a substantial increase in sugarcane. Again, barring a few exceptions, area was the more important factor in the growth of its output. Oilseeds grew rapidly in about half the districts in the "high" category, but only in Jullundur in the "low" group. Other districts did not show any marked increase in the output of oilseeds. It is interesting to note that, in several districts, a major part of the increase in oilseeds is explained by rise in productivity. Cotton, "desi" and "American", showed a rapid increase of over 6 per cent in only about one third and one half of all the districts respectively, mainly due to increase in area. While the growth of "desi" cotton did not bear a consistent relationship with the pattern of growth of aggregate output, that of "American" cotton corresponded closely to the aggregate trend in the "high" growth groups. The wide divergence observed in the trends in rates of growth of different crops imply shifts in their contribution to total output. This is evident from the analysis in the following section.

Wheat, the most important food crop in Punjab at all times, assumed added significance in the years 1960-1963 to 1968-1971 with the introduction of high-yielding varieties. Its output grew by 12 per cent per annum, almost double the rate of increase in aggregate output. While the output of wheat per acre increased faster than average rise in productivity, the relative increase in area under the crop is also spectacular, being 5.1 per cent per annum, more than four times the over-all rate of area extension. Other crops which recorded high rates of growth relative to aggregate output as well as in comparison with the trends in the preceding period are bajra, barley and maize. The output of rice sustained a growth of 5.7 per cent per annum, mainly due to area increase. Among the other important food crops, gram registered a striking decline of 5:4 and 7.2 per cent per annum in output and acreage respectively. The record of non-food crops was generally far from impressive. Sugarcane maintained a modest increase of 4.2 per cent; "desi" cotton was virtually stagnant. Oilseeds (excluding groundnut) and chillies showed an absolute decline. In fact, in the 1960s they showed a marked deceleration compared with the 1950s.

Wheat showed much higher rates of growth than those of the aggregated output of all crops in all the districts. There is a close association between relative rates of increase in the output of wheat and the relative agricultural growth in different districts. In new Punjab, Ludhiana, Kapurthala, Amritsar, Gurdaspur, Bhatinda and Jullundur ranked high in terms of growth of over-all agricultural output as well as increase in the production of wheat. In Haryana, only Karnal district attained an aggregate agricultural rate comparable to that of new Punjab and also a phenomenal increase of 15 per cent per annum in wheat. Mahendragarh is the only Haryana district where an over-all growth rate of 3.9 per cent was combined with a 17 per cent increase in the output of wheat. Of this increase, 11.9 per cent was attributable to expansion of area. However, Mahendragarh's base was low, the share of wheat in total acreage under crops being only 2.0 per cent in the years 1960-1963.

Both increase in area and increase in output per acre were important in contributing to the phenomenal growth of wheat production. However, there was no consistent trend in the relative significance of the two factors. Of the eight "high" growth districts, area played a somewhat more important role in Ludhiana, Karnal and Bhatinda, while productivity was much more dominant in the other five districts of this group.

Rice also recorded a striking increase of the order of 13.6, 13.1 and 10.3 per cent in Ludhiana, Rohtak and Amritsar respectively. The rates observed in other districts were also impressive, ranging from 5 to 9 per cent; the two exceptions were Hissar and Ambala which showed absolute declines of 1.9 and 1.6 per cent. In general, high rate of growth in the output of rice was also associated with similar trends in over-all agricultural growth. However, the major gain in rice was mainly due to increase in area. Amritsar is the only district which had a rate of increase of productivity of rice as high as

4.1 per cent. This was combined with an above-average increase in area under rice of 5.9 per cent.

A significant rate of increase was also observed in the output of bajra, although this bears no consistent relationship with over-all rates of growth. Ludhiana, Kapurthala and Bhatinda, high growth districts, did show phenomenal growth rates of 30, 33 and 19 per cent respectively. However, comparable rates were also noticed in Patiala (36 per cent) and Ambala (19.5 per cent). On the other hand, the output of bajra remained virtually stagnant in Amritsar and showed an absolute decline of 1.4 per cent per annum in Gurdaspur. The contribution of productivity to the unprecedented gains in bajra output was, in general, even more important than it was in the case of wheat. Kapurthala and Patiala were the major exceptions, but, even in these districts, area increases of the order of 19.7 and 18.3 per cent respectively were combined with productivity gains of 11.4 and 14.6 per cent respectively.

Barley is a crop of comparatively greater importance in Haryana than in new Punjab and had rates of growth ranging from 0.5 per cent to 22 per cent in the districts of Haryana. The highest rate recorded in the new Punjab was only 3.6 per cent in Sangrur; six districts in the state showed an absolute decline.

Maize is an important crop, mostly in new Punjab, and had high rates of output growth in several districts in the "high" output growth group, although tne rates were lower than those of wheat. Only in Gurdaspur did maize record an absolute decline. Among the districts of Haryana, Gurgaon with 8 per cent increase was the only district that had a higher than average annual increase. At the state level, area increase was somewhat more important than productivity change in contributing to the growth. Across the districts, there was no consistent trend.

Gram was the crop next in importance to wheat in the years 1960-1963. It experienced a significant decline in 1968-1971 in all but one district, however, Mahendragarh, which also had a slight decline in area under the crop, experienced a perceptible rise in productivity. The decline was generally more precipitous in the "high" output growth group in the 1960s and was mainly caused by the diversion of acreage to other crops.

It has already been noted that non-food crops failed to keep pace with the foodgrains during the 1950s and 1960s. However, there were a few exceptions at the district level. Sugarcane recorded a high increase of 16 per cent in Hissar and 20.5 per cent in Bhatinda. In the former district, area and productivity gains were of equal importance; in Bhatinda, however, increase in area was the dominant factor. The growth of sugarcane was phenomenal in Mahendragarh (75 per cent per annum), but not much importance should be attached to it in view of the extremely low figures in the base period. Cotton (desi) declined in most districts, the major exceptions being Hissar and Karnal, where the increase was 10.1 and 14.5 per cent respectively. This increase was mainly due to increase in area. Similarly, cotton (American) did not show an encouraging record except in Hissar and Bhatinda. Groundnut showed a reasonably favourable trend, sustained largely by area gains, in the districts where it was an important crop, i.e. Ambala, Jullundur, Ludhiana, Kapurthala, Patiala and Sangrur. Not much significance should be attached to the high rates recorded by Hoshiarpur, Ferozepur and Bhatinda where its share in the base period output was virtually negligible. Oilseeds other than groundnuts, however, showed a precipitous decline in nearly all the districts (Hissar, Gurgaon, Bhatinda and Mahendragarh) where they had formed a significant component of the crop basket in the base period. The decline was attributable mainly to diversion of acreage. The increases of 13.5 per cent and 12.3 per cent in the output of oilseeds in Jullundur and Kapurthala were again not of much significance since their share in total output in the base period was less than 0.4 per cent. Finally, chillies formed a very high-value crop of substantial importance in Amritsar and Patiala in the base period, but suffered a heavy decline in both districts during the 1960s.

3. Shifts in crop pattern

For convenience of analysis, the crops were classified into high-value and low-value groups. High-value crops are those whose share in value is higher than their share in area, and low-value crops are those whose share in area exceeds their share in value. The ratios of shares of different crops in value of total output to those in area during 1951-1961 are given in table 30.

The crops with ratios greater than unity were classified as "high-value" crops. All the non-food crops and rice, wheat and potatoes in the food group appear in this category in both periods. Maize was a marginal crop, its share in value being a little higher than unity in the base year but a little lower in the final year. It is a high-yielding crop in physical terms, but its share in value is depressed by its relatively low price. Any crop may be in either the low-value or the high-value group depending on changes in technology (which may have a differential impact on the productivity of different crops) and in relative prices.

Table 30. Ratios of share in value to share in area for different crops in Punjab, 1951 and 1961

Crop	1951	1961
Rice	1.09	1.14
Wheat	1.25	1.18
Barley	0.61	0.54
Jowar	0.23	0.13
Bajra	0.35	0.29
Maize	1.17	0.86
Gram	0.83	0.68
Other pulses	0.88	0.87
Potatoes	9.71	10.93
Chillies	4.04	4.13
Sugarcane	3.89	3.71
Groundnut	16.09	11.53
Oilseeds	1.09	1.56
Cotton (desi)	0.86	1.10
Cotton (American)	1.87	1.61
Tobacco	3.97	7.50
Tea	4.82	5.56
Foodgrains	0.85	0.82
Non-foodgrains	1.76	1.88

The five most important crops in various years, ranked in order of their respective contribution to output and area, are presented in tables 31 and 32. In 1951-1954, wheat was the dominant crop in Punjab in terms of both value and area, followed by gram. Sugarcane ranked third in value but did not appear among the first five crops ranked in order of area. Maize and bajra occupied the fourth and fifth places in value and the third and fourth places in area.

In 1960-1963, maize and bajra did not rank among the first five in output; they were replaced by oilseeds and rice. The allocation of area, however, showed only minor changes. Jowar, which accounted for about 5 per cent of the area in 1951-1954, was replaced by rice. Sugarcane and oilseeds were not among the first five in area, even though they were among the first five in output, evidently because they require relatively much less land to produce output of a given value.

Significant shifts in crop pattern over time may be noted at the district level. In 1951-1954, wheat was the dominant crop in terms of output in most of the districts, as was the case at the state level. In Hissar, however, it was gram and, in Mahendragarh, it was bajra. In terms of value, the crop pattern has generally been shifted in the direction of relatively high-value crops in most of the seven districts which recorded "high" rates of output growth in the 1950s. The shift was particularly marked in "high" growth districts, such as Hissar, Gurgaon and Mahendragarh, and in "low" growth Rohtak whose inferior crop patterns included large amounts of gram. While gram gained during 1960-1963, there was a distinct tendency towards a decline in the importance of barley and bajra. On the other hand, relative gains were noted in such non-food crops as oilseeds in Hissar, Gurgaon, Bhatinda, Mahendragarh and Patiala; sugarcane in Rohtak, Karnal, Gurdaspur and Sangrur, and cotton in Ferozepur and Bhatinda.

The allocation of area in 1960-1963 showed more or less the same trend as the crop pattern, the area under relatively high-value crops gaining at the expense of the low-value crops. Thus, a significant relative increase in area was recorded by wheat in Hissar and Karnal, oilseeds in Hissar and Mahendragarh and rice in Karnal and Patiala. On the other hand, the area under inferior crops like bajra and jowar showed a significant decline. As expected, the changes in the allocative pattern of area were less pronounced than those in terms of value.

The most notable change in the cropping pattern during the 1960s was the increase in the importance of wheat, largely at the expense of gram. At the state level, the share of wheat in total output increased from 31.7 per cent in 1960-1963 to 51.3 per cent in 1968-1971, while that of gram declined from 18.7 per cent to 7.5 per cent. Since wheat was mainly of high-yielding variety, the gain in area was comparatively smaller; the area under wheat increased from about 27 to 37 per cent. Sugarcane and cotton, the two major commercial crops of Punjab, showed minor relative loss in output during this period. Cotton appeared among the first five during the 1960s, replacing oilseeds.

The tendency towards the substitution of wheat for gram was manifest in all the districts, though in varying degrees. The relative gain in wheat was more striking in the districts with comparatively high rates of agricultural growth between 1963 and 1971. The increase in its share ordinarily exceeded 20 per cent in the "high" growth group and was as high as 26 per cent in Ludhiana and 23 per cent in Karnal. On the other hand, it was around 8 per cent in Hissar, Ambala and Mahendragarh, the districts with the poorest over-all performance during this period. Another change worth noting was the relative increase in bajra, perhaps also attributable to the introduction of high-yielding varieties. However, the increase was mainly confined to the relatively poor districts of Hissar, Gurgaon and Rohtak.

Table 31. Average share of the first five crops (ranked in order of share in output) in total output in the districts of Punjab, 1951-1971

							Total
Hissar	1951-1954	Gram 37.2	Bajra 24.4	Wheat 11.8	Cotton 7.8	Oilseeds 5.0	86.2
	1960-1963	Gram 42.6	Wheat 18.3	Oilseeds 13.3	Cotton 7.4	Bajra 7.0	88.6
	1968-1971	Wheat 26.9	Gram 20.3	Cotton 16.0	Bajra 13.6	Sugarcane 10.7	87.5
Rohtak	1951-1954	Wheat 25.8	Sugarcane 25.0	Gram 21.8	Bajra 11.2	Jowar 5.0	88.8
	1960-1963	Sugarcane 34.3	Wheat 29.8	Gram 24.3	Bajra 3.9	Oilseeds 2.5	94.8
	1968-1971	Wheat 43.4	Sugarcane 26.9	Bajra 7.1	Gram 14.0	Rice 2.1	93.5
Gurgaon	1951-1954	Wheat 23.7	Barley 19.6	Bajra 17.6	Oilseeds 14.5	Gram 10.1	85.5
	1960-1963	Gram 26.4	Wheat 25.9	Oilseeds 19.9	Sugarcane 10.5	Bajra 5.3	88.0
	1968-1971	Wheat 43.7	Gram 13.6	Bajra 12.7	Sugarcane 10.0	Barley 9.9	89.9
Karnal	1951-1954	Wheat 29.8	Gram 21.7	Sugarcane 13.1	Rice 7.6	Bajra 4.8	77.0
	1960-1963	Wheat 29.6	Gram 21.3	Sugarcane 17.2	Rice 14.4	Oilseeds 2.9	85.4
	1968-1971	Wheat 52.90	Sugarcane 14.96	Rice 14.5	Gram 6.3	Oilseeds 2.3	91.0
Ambala	1951-1954	Wheat 30.4	Sugarcane 19.7	Gram 15.8	Maize 7.8	Rice 6.2	79.9
	1960-1963	Wheat 23.9	Sugarcane 22.1	Gram 19.1	Rice 11.7	Maize 11.5	88.3
	1968-1971	wheat 31.8	Sugarcane 25.0	Maize 12.5	Rice 8.5	Gram 7.7	85.5
Hoshiarpur	1951-1954	Wheat 37.7	Maize 17.8	Sugarcane 15.1	Gram 13.7	Rice 5.6	89.9
	1960-1963	Wheat 30.1	Maize 20.3	Sugarcane 14.8	Gram 12.1	Rice 9.6	86.9
	1968-1971	Wheat 47.7	Maize 18.7	Cotton 10.1	Rice 8.8	Sugarcane 8.3	93.5
Jullundur	1951-1954	Wheat 43.3	Sugarcane 19.8	Maize 17.1	Gram 6.4	Potatoes 2.9	89.5
	1960-1963	Wheat 38.9	Sugarcane 20.3	Maize 11.1	Potatoes 9.2	Gram 8.3	87.8
	1968-1971	Wheat 58.8	Maize 11.6	Sugarcane 11.2	Potatoes 8.2	Groundnut 4.3	94.1

(Cont'd)

Table 31 (Cont'd)

							Total
Ludhiana	1951-1954	Wheat 39.0	Gram 12.1	Maize 12.0	Sugarcane 10.6	Oilseeds 9.1	82.8
	1960-1963	Wheat 41.7	Gram 12.4	Maize 11.6	Sugarcane 9.1	Cotton 9.7	84.5
	1968-1971	Wheat 68.9	Maize 13.2	Groundnut 7.5	Sugarcane 4.5	Cotton 2.8	96.9
Ferozepur	1951-1954	Wheat 35.4	Gram 22.0	Cotton 20.8	Rice 3.7	Oilseeds 3.6	85.5
	1960-1963	Wheat 37.7	Cotton 29.7	Gram 16.0	Oilseeds 3.3	Rice 5.2	91.9
	1968-1971	Wheat 55.0	Cotton 22.2	Rice 5.1	Gram 4.2	Maize 4.1	90.6
Amritsar	1951-1954	Wheat 36.5	Sugarcane 11.1	Gram 10.7	Maize 9.1	Rice 8.5	75.9
	1960-1963	Wheat 39.0	Rice 11.6	Gram 9.4	Sugarcane 8.9	Maize 7.0	75.9
	1968-1971	Wheat 61.4	Rice 12.6	Sugarcane 6.9	Maize 6.1	Oilseeds 4.8	91.8
Gurdaspur	1951-1954	Wheat 40.0	Sugarcane 15.2	Rice 12.1	Maize 6.8	Gram 5.1	79.2
	1960-1963	Wheat 37.0	Sugarcane 20.9	Rice 18.7	Gram 5.4	Maize 4.5	86.5
	1968-1971	Wheat 55.3	Rice 17.9	Sugarcane 17.6	Oilseeds 2.8	Maize 2.3	95.9
Bhatinda	1951-1954	Wheat 32.4	Gram 28.8	Cotton 15.4	Bajra 8.9	Oilseeds 4.4	89.9
	1960-1963	Wheat 36.3	Gram 29.9	Cotton 22.8	Oilseeds 7.0	Bajra 3.6	99.6
	1968-1971	Wheat 54.1	Cotton 19.9	Gram 8.3	Bajra 7.9	Sugarcane 4.3	94.5
Kapurthala	1951-1954	Wheat 53.4	Sugarcane 17.9	Maize 9.9	Gram 7.4	Rice 3.2	91.8
	1960-1963	Wheat 27.1	Sugarcane 17.4	Rice 15.4	Gram 8.6	Maize 8.0	76.5
	1968-1971	Wheat 59.9	Rice 14.5	Maize 8.1	Groundnut 7.1	Sugarcane 5.8	95.4
Mahendragarh	1951-1954	Bajra 56.7	Barley 15.8	Gram 8.9	Wheat 9.9	Jowar 5.6	96.9
	1960-1963	Gram 36.6	Bajra 32.7	Oilseeds 19.8	Wheat 6.6	Barley 4.1	99.8
	1968-1971	Gram 34.9	Bajra 30.4	Wheat 15.8	Oilseeds 6.4	Barley 5.1	92.6

(Cont'd)

Table 31 (Cont'd)

							Total
Patiala	1951-1954	Wheat 38.8	Maize 12.2	Sugarcane 12.1	Gram 12.0	Chillies 10.0	85.1
	1960-1963	Wheat 38.8	Gram 11.7	Sugarcane 9.7	Chillies 7.4	Oilseeds 6.7	74.3
	1968-1971	Wheat 60.0	Sugarcane 8.6	Rice 8.4	Maize 5.8	Groundnut 4.2	87.0
Sangrur	1951-1954	Wheat 29.7	Gram 27.0	Cotton 12.3	Bajra 7.2	Sugarcane 6.8	83.0
	1960-1963	Wheat 35.3	Gram 27.6	Cotton 14.1	Sugarcane 9.7	Oilseeds 4.8	91.5
	1968-1971	Wheat 59.5	Gram 9.2	Sugarcane 6.8	Maize 6.7	Bajra 6.0	88.2
Total	1951-1954	Wheat 32.4	Gram 17.9	Sugarcane 10.3	Maize 7.0	Bajra 6.5	74.1
	1960-1963	Wheat 31.7	Gram 18.7	Sugarcane 11.5	Oilseeds 6.2	Rice 6.1	74.2
	1968-1971	Wheat 51.3	Sugarcane 10.3	Gram 7.5	Cotton 7.0	Rice 5.8	81.9

Sources: Government of India, Directorate of Economics and Statistics, ***Estimates of Area and Production of Principal Crops*** for relevant years.

Sugarcane, considered for a long time to be a highly remunerative crop, showed, in general, a declining trend. Its relative decline was marked in several "high" growth districts, being as much as 10 per cent in Jullundur and 12 per cent in Kapurthala. Cotton, another remunerative crop, was among the highest-value crops in 5 districts in 1960-1963. It was no longer a high-value crop in Sangrur in 1968-1971, and declined in Ludhiana, Ferozepur and Bhatinda. In Hissar, however, the share of cotton rose from 7.4 per cent in 1960-1963 to 16 per cent in 1968-1971. It appeared among the highest five in Hoshiarpur in 1968-1971. Another big casualty wa oilseeds in Hissar, Gurgaon, Mahendragarh and Bhatinda.

The changes in the crop pattern may be summed up in terms of a twofold classification of crops: (a) the conventional division between food and non-food crops, and (b) the respective shares of high-value and low-value crops, as defined above.

Data in tables 33 and 34 show marginal substitution of non-food crops for food crops at the state and district levels in the 1950s. Hissar and Mahendragarh recorded the most impressive increases in the share of non-food crops during the period. Variations in other districts were of a relatively minor order and did not show any consistent pattern. The recent period, 1960-1963 to 1968-1971, saw an almost uniform trend of significant rise in the share of food crops in total output, the two minor exceptions being Hissar and Ambala. The accompanying small decline in area devoted to food crops suggests the predominant role of productivity gains in raising the share of food crops.

Tables 35 and 36 show the percentage share of output and area of high-value and low-value crops, and brings out the close association between the share of high-value crops in total output and share of area in 1951-1954. Between 1951-1954 and 1960-1963, the share of high-value crops in the total output increased in all the districts. Since 1960-1963, it has increased even faster than in the previous decade. The gains have been more marked in some of the "high" output growth districts. The percentage gain in output of high-value crops was very slightly higher than the relative changes in the food and non-food groups. On the other hand, the relative gain of the high-value crops in terms of area was larger than the increase in acreage of food crops.

Table 32. Average share of the first five crops (ranked in order of share in area) in gross sown area in the districts of Punjab, 1951-1971

							Total
Hissar	1951-1954	Bajra 50.9	Gram 23.7	Jowar 7.0	Wheat 5.6	Oilseeds 4.4	91.6
	1960-1963	Gram 48.4	Bajra 19.6	Wheat 10.1	Oilseeds 6.8	Jowar 5.3	90.2
	1968-1971	Gram 28.9	Bajra 27.4	Wheat 15.0	Cotton 16.4	Oilseeds 3.0	90.7
Rohtak	1951-1954	Bajra 27.3	Gram 23.5	Jowar 18.9	Wheat 16.9	Sugarcane 4.8	91.4
	1960-1963	Gram 30.3	Wheat 20.8	Bajra 16.7	Jowar 16.3	Sugarcane 7.3	91.4
	1968-1971	Wheat 30.7	Gram 20.0	Bajra 17.0	Jowar 13.2	Sugarcane 7.6	88.5
Gurgaon	1951-1954	Bajra 36.2	Barley 15.1	Jowar 12.4	Wheat 11.4	Gram 11.3	86.4
	1960-1963	Gram 28.3	Bajra 25.8	Wheat 14.6	Jowar 10.5	Oilseeds 8.8	88.0
	1968-1971	Bajra 26.1	Wheat 25.9	Gram 18.9	Barley 11.0	Jowar 7.4	89.3
Karnal	1951-1954	Gram 27.2	Wheat 24.4	Bajra 10.7	Jowar 9.9	Rice 8.2	80.4
	1960-1963	Gram 27.3	Wheat 26.5	Rice 13.9	Maize 7.5	Jowar 5.4	80.6
	1968-1971	Wheat 40.9	Rice 20.0	Gram 10.7	Maize 6.2	Sugarcane 5.4	83.2
Amritsar	1951-1954	Wheat 38.7	Gram 15.4	Oilseeds 9.0	Maize 8.4	Rice 8.3	79.8
	1960-1963	Wheat 39.4	Rice 13.4	Gram 12.3	Cotton 10.8	Maize 10.5	86.4
	1968-1971	Wheat 50.0	Rice 17.7	Maize 10.4	Oilseeds 6.1	Gram 3.6	87.8
Gurdaspur	1951-1954	Wheat 43.5	Rice 13.9	Maize 8.8	Pulses 7.5	Gram 6.3	80.0
	1960-1963	Wheat 44.2	Rice 18.8	Maize 7.5	Gram 6.8	Pulses 6.2	83.5
	1968-1971	Wheat 44.5	Rice 24.1	Maize 10.0	Sugarcane 7.0	Other pulses 4.7	90.3

(Cont'd)

Table 32 (Cont'd)

							Total
Bhatinda	1951-1954	Gram 39.1	Wheat 22.3	Bajra 14.1	Cotton 11.1	Barley 6.2	92.8
	1960-1963	Gram 37.6	Wheat 25.5	Cotton 17.8	Bajra 9.3	Oilseeds 5.3	95.5
	1968-1971	Wheat 39.9	Gram 19.1	Bajra 13.3	Cotton 17.4	Maize 3.1	92.8
Kapurthala	1951-1954	Wheat 54.7	Maize 12.1	Gram 9.4	Rice 6.9	Sugarcane 9.5	92.6
	1960-1963	Wheat 48.9	Rice 14.3	Maize 11.7	Gram 9.2	Sugarcane 5.7	89.8
	1968-1971	Wheat 49.1	Rice 19.0	Maize 12.5	Groundnut 10.7	Sugarcane 2.9	94.2
Mahendragarh	1951-1954	Bajra 72.0	Gram 10.5	Jowar 7.7	Barley 6.2	Oilseeds 1.1	97.5
	1960-1963	Bajra 45.7	Gram 35.1	Oilseeds 6.8	Jowar 5.1	Barley 3.6	96.3
	1968-1971	Bajra 49.7	Gram 34.8	Wheat 5.0	Barley 3.6	Jowar 2.8	95.9
Ambala	1951-1954	Wheat 30.7	Gram 19.1	Maize 10.3	Rice 9.0	Sugarcane 7.2	76.3
	1960-1963	Wheat 28.5	Gram 20.6	Maize 15.0	Rice 11.1	Sugarcane 8.8	84.0
	1968-1971	Wheat 32.4	Sugarcane 14.2	Maize 13.7	Gram 12.8	Rice 10.6	83[illegible]
Hoshiarpur	1951-1954	Wheat 41.5	Maize 21.9	Gram 15.0	Sugarcane 5.6	Rice 5.4	89.4
	1960-1963	Wheat 36.0	Maize 23.1	Gram 17.8	Rice 10.0	Sugarcane 5.7	92.6
	1968-1971	Wheat 45.3	Maize 25.2	Rice 10.8	Gram 7.3	Sugarcane 3.7	92.3
Jullundur	1951-1954	Wheat 51.8	Maize 15.7	Gram 11.7	Sugarcane 8.4	Cotton 4.0	91.6
	1960-1963	Wheat 46.8	Maize 16.8	Gram 12.9	Sugarcane 7.6	Rice 3.5	87.6
	1968-1971	Wheat 53.4	Maize 21.6	Groundnut 7.8	Sugarcane 5.8	Rice 3.9	92.5

(Cont'd)

Table 32 (Cont'd)

							Total
Ludhiana	1951-1954	Wheat 39.7	Gram 20.7	Maize 11.8	Groundnut 10.7	Sugarcane 4.0	86.9
	1960-1963	Wheat 40.9	Gram 16.1	Maize 14.8	Groundnut 10.8	Cotton (D) 10.5	93.1
	1968-1971	Wheat 53.3	Maize 18.4	Groundnut 16.3	Cotton 4.4	Sugarcane 2.5	94.9
Ferozepur	1951-1954	Wheat 31.9	Gram 29.9	Cotton 13.9	Bajra 6.8	Barley 4.8	87.3
	1960-1963	Wheat 38.8	Gram 21.6	Cotton 20.9	Rice 4.5	Maize 3.3	89.1
	1968-1971	Wheat 46.8	Cotton 13.3	Gram 8.6	Rice 6.9	Maize 5.9	81.5
Patiala	1951-1954	Wheat 40.0	Maize 13.8	Gram 13.7	Oilseeds 9.0	Cotton 6.0	82.5
	1960-1963	Wheat 38.0	Gram 20.0	Maize 9.0	Rice 8.0	Cotton 7.0	82.0
	1968-1971	Wheat 49.2	Rice 12.9	Maize 9.2	Groundnut 6.9	Gram 6.6	84.8
Sangrur	1951-1954	Gram 31.6	Wheat 22.6	Bajra 15.4	Cotton 9.4	Maize 4.5	83.5
	1960-1963	Gram 32.0	Wheat 28.0	Cotton 11.2	Bajra 9.0	Maize 5.4	85.6
	1968-1971	Wheat 42.4	Gram 15.1	Bajra 12.2	Maize 8.6	Cotton 7.2	85.5
Total	1951-1954	Wheat 25.9	Gram 21.5	Bajra 18.6	Maize 6.1	Jowar 4.8	76.9
	1960-1963	Gram 27.7	Wheat 26.9	Bajra 10.5	Maize 6.5	Rice 5.4	77.0
	1968-1971	Wheat 36.6	Gram 14.1	Bajra 12.1	Cotton 7.4	Maize 7.3	77.5

Source: As for table 31.

Table 33. Percentage shares of food and non-food crops (output) in the districts of Punjab, 1951-1971

District	Food			Non-food		
	1951-1954	1960-1963	1968-1971	1951-1954	1960-1963	1968-1971
Hissar	81.1	74.1	68.0	18.5	25.7	31.6
Rohtak	67.2	57.5	70.7	32.6	42.1	29.3
Gurgaon	76.5	68.2	82.5	23.4	31.7	17.3
Karnal	72.1	75.2	80.9	27.7	24.3	19.0
Ambala	65.6	71.0	68.8	34.3	28.9	31.1
Hoshiarpur	78.9	82.5	89.4	20.9	17.4	11.0
Jullundur	68.8	70.5	82.2	30.9	29.3	17.8
Ludhiana	65.0	70.6	84.8	35.0	29.3	15.2
Ferozepur	71.3	63.6	71.8	28.9	36.3	28.2
Amritsar	67.6	71.9	83.5	30.2	28.1	16.5
Gurdaspur	72.5	73.8	79.1	27.4	26.1	20.8
Bhatinda	73.7	65.7	72.9	26.3	33.7	27.1
Kapurthala	75.7	72.7	85.4	23.6	27.2	14.6
Mahendragarh	97.5	79.8	88.8	2.9	20.1	10.7
Patiala	66.6	68.1	79.3	33.9	31.8	20.6
Sangrur	73.2	68.6	84.5	26.6	31.2	15.4
Total	72.9	70.0	78.2	26.9	30.0	21.8

Source: Government of India, Directorate of Economics and Statistics, *Estimates of Area and Production of Principal Crops in India* reports for relevant years.

Table 34. Percentage shares of food and non-food crops (area) in the districts of Punjab, 1951-1971

District	Food			Non-food		
	1951-1954	1960-1963	1968-1971	1951-1954	1960-1963	1968-1971
Hissar	92.0	88.1	78.9	7.9	11.7	21.2
Rohtak	90.6	87.7	88.4	9.3	12.0	11.6
Gurgaon	87.8	88.3	81.8	12.2	11.7	17.9
Karnal	87.8	89.7	88.9	11.9	10.2	10.9
Ambala	81.7	82.3	76.5	18.1	11.7	23.2
Hoshiarpur	90.7	91.5	89.9	8.9	8.3	10.1
Jullundur	83.9	82.9	83.0	15.7	16.9	17.0
Ludhiana	75.6	74.5	76.0	23.9	25.4	23.7
Ferozepur	80.9	74.9	77.9	18.8	25.0	22.2
Amritsar	76.8	80.3	85.1	22.9	19.6	14.9
Gurdaspur	84.9	88.8	88.4	14.0	11.1	11.7
Bhatinda	83.2	76.2	77.2	16.4	23.7	22.5
Kapurthala	88.2	86.9	84.1	11.4	13.0	15.8
Mahendragarh	98.7	93.1	98.0	1.1	6.8	1.9
Patiala	75.4	79.9	82.3	24.4	20.1	17.7
Sangrur	82.2	80.6	85.6	17.4	19.3	14.3
Total	86.3	84.1	83.6	13.7	15.8	16.3

Source: Same as table 33.

Table 35. Percentage shares of high-value and low-value crops (output) in the districts of Punjab, 1951-1971

District	High-value crops			Low-value grops		
	1951-1954	1960-1963	1968-1971	1951-1954	1960-1963	1968-1971
Hissar	31.7	46.6	60.1	68.3	53.3	39.8
Rohtak	59.0	72.1	74.8	41.0	27.8	24.2
Gurgaon	46.3	57.8	61.9	53.7	42.2	38.0
Karnal	64.0	70.4	86.5	36.0	29.5	13.5
Ambala	69.0	68.3	71.4	31.0	31.7	28.6
Hoshiarpur	62.8	65.1	67.4	37.2	34.9	32.6
Jullundur	74.6	81.2	87.0	25.4	18.8	13.0
Ludhiana	75.5	76.3	84.7	24.5	23.6	15.2
Ferozepur	68.1	80.4	88.2	31.9	19.6	11.8
Amritsar	75.2	79.2	90.0	24.8	20.8	10.0
Gurdaspur	72.7	84.3	93.8	27.3	15.6	6.4
Bhatinda	54.8	70.3	80.8	45.2	29.7	19.2
Kapurthala	79.3	79.0	89.1	20.7	21.0	10.9
Mahendragarh	12.8	22.8	26.7	87.2	77.1	73.3
Patiala	76.7	80.6	88.9	23.3	19.4	11.0
Sangrur	57.0	67.9	76.6	43.0	32.1	23.4
Total	61.6	69.3	78.7	38.4	31.6	21.2

Note: High-value crops are those whose share in value is higher than their share in area; low-value crops are those whose share in area exceeds their share in value.

Table 36. Percentage shares of high-value and low-value crops (area) in the districts of Punjab, 1951-1971

District	High-value crops			Low-value crops		
	1951-1954	1960-1963	1963-1971	1951-1954	1960-1963	1968-1971
Hissar	14.2	23.2	37.5	85.8	76.8	62.5
Rohtak	26.7	33.6	44.8	73.3	66.2	55.2
Gurgaon	23.6	36.8	41.2	75.9	63.2	58.7
Karnal	44.7	50.9	71.8	55.3	49.0	28.2
Ambala	56.9	56.5	66.2	43.0	43.5	33.8
Hoshiarpur	56.0	55.1	63.1	43.9	44.9	36.8
Jullundur	68.2	68.5	67.3	31.6	31.5	32.7
Ludhiana	62.9	67.1	77.9	37.0	32.8	22.0
Ferozepur	54.8	71.1	75.9	45.0	29.8	24.1
Amritsar	70.5	72.5	88.6	29.4	27.5	11.4
Gurdaspur	71.5	74.3	80.0	28.5	25.7	20.0
Bhatinda	39.0	49.1	62.5	61.0	50.9	37.5
Kapurthala	73.2	76.5	83.8	26.8	24.5	16.2
Mahendragarh	2.5	8.8	6.9	97.4	91.1	93.0
Patiala	64.3	69.8	79.7	35.7	31.2	20.2
Sangrur	39.6	48.9	59.1	60.4	51.0	40.9
Total	43.4	47.7	59.0	56.6	52.2	41.0

Note: As for table 35.

4. Component—analysis of increase in output

Analysis of the rates of increase in agricultural output in different districts has highlighted the spatial pattern of agricultural growth in Punjab during the period 1951-1954 to 1960-1963, as well as the variations in the three major components of growth area, productivity, and crop pattern. An attempt is made here to quantify the respective contributions of each of the three elements to the growth of crop output in various districts. The formal scheme of decomposition adopted for this purpose is largely based on work of Minhas and Vaidyanathan[1] with a slight modification.[2] The main results obtained from the decomposition of the aggregate growth are presented in table 37.

The first row of figures for each district in the table gives the absolute growth rate over the period under study and the portions of this growth attributable to the different elements, while the figures in parentheses in the second row indicate the respective contributions (in percentage terms) to the aggregate growth rate.

As can be seen from the table, during 1951-1954 to 1960-1963 a little more than half (60 per cent) of the growth in total agricultural output in Punjab was accounted for by extension of area under cultivation. Agricultural output in the state would have grown at the rate of about 3 per cent per annum if the only contributor to increase in agricultural output had been increase in cropped area. Rise in yield per acre and improvement in the crop pattern explained roughly one fourth and one fifth of the growth in total output respectively, the remainder being due to the interaction effect.

The relative importance of different components varied from one district to another. As at the state level, area was the dominant factor in the growth of output in most of the districts, the major exceptions being Hissar, Sangrur and Mahendragarh in the "high" growth category and Hoshiarpur, Rohtak, Amritsar and Ludhiana in the "low" growth group. Kapurthala presents a peculiar case where each component is a multiple of the aggregate growth, evidently because some of the effects have large negative values; the area effect was almost five times the total growth, while the yield effect worked in the negative direction.

As expected, the yield effect turned out to be very important in absolute terms in most of the "high" growth districts, Hissar and Karnal being the only notable exceptions. The share of the yield effect in the aggregate growth also appears to be relatively high in the districts recording "low" rates of output growth, the only exceptions being Rohtak, Ferozepur and Kapurthala. The latter, in fact, showed an absolute decline in yield per acre.

The crop pattern effect was the most important component in only two districts, Hissar and Rohtak, and was second only to the area effect in Karnal and Ferozepur. As expected, the absolute magnitude of the crop pattern effect was higher in the "high" growth districts than in the "low" growth districts, Ambala in the "low" group and Patiala in the "high" group being the only major exceptions. In Ambala, the contribution of crop pattern was positive but low, while in Patiala it was negative. Kapurthala was another district which showed a negative crop pattern effect in the period 1951-1954 to 1960-1963.

Analysis of agricultural growth in the 1960s at the state level brings out the dominant role of the yield effect, which is in sharp contrast to the pattern in the 1950s. Rise in yield per acre accounted for 55 per cent of the growth in total output in the state, as against its contribution of 26 per cent in the preceding decade. Some improvement was also observed in the crop pattern effect, its percentage contribution rising from 19 to about 28 per cent. The relative area effect, on the other hand, dropped from 53 to only 16 per cent.

Rise in productivity was the dominant factor in agricultural growth of all the districts except Ambala and Hoshiarpur. Improvement in crop pattern was a factor of substantial importance, but only in some districts. Among the districts in the "high" output growth group, it was second in importance only in Karnal, Bhatinda and Sangrur. There was a major shift in the crop pattern in the whole group, caused by the striking increase in the share of wheat, but since this was partly offset by the relative decline in a few other high-value crops, notably sugarcane and cotton, the crop pattern effect did not appear to have much significance. Area increase is a factor of consequence in nearly all the "high" growth districts, but was uniformly overshadowed by the yield effect.

5. Pattern of land use

As already noted, the contribution of area increase to agricultural growth was very important in the 1950s and positive but less significant in the recent period. Changes in the pattern of land utilization are given in table 38. In the state as a whole, net sown area increased between 1951-1954 and 1960-1963 at the expense of both cultivable wastes and fallows.

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[1] B.S. Minhas and A. Vaidyanathan, "Growth of crop output in India, 1951-1954 to 1958-1961", *Journal of the Indian Society of Agricultural Statistics*, 1965.

[2] The original scheme of decomposition and its modified version are given in annex IV.

Table 37. Relative contribution of different elements of growth of agricultural output in the districts of Punjab, 1951-1971

District	Area effect	Yield effect	Crop pattern effect	Inter-action term	Percentage growth in output
			1951-1954 to 1960-1963		
Hissar	65.2 (42.4)	18.0 (11.7)	69.1 (45.0)	1.3 (0.8)	153.6 (100.0)
Rohtak	20.6 (41.3)	0.7 (1.4)	25.0 (50.1)	3.6 (7.2)	49.9 (100.0)
Gurgaon	28.1 (45.1)	19.3 (31.0)	13.4 (21.5)	1.5 (2.4)	62.3 (100.0)
Karnal	58.7 (63.7)	13.0 (14.1)	25.1 (27.2)	-4.6 (-5.0)	92.2 (100.0)
Ambala	18.8 (41.8)	18.6 (41.3)	5.5 (12.2)	2.1 (4.7)	45.0 (100.0)
Hoshiarpur	9.0 (22.6)	19.2 (48.1)	8.4 (21.0)	3.3 (8.3)	39.9 (100.0)
Jullundur	29.3 (65.3)	8.2 (18.2)	5.7 (12.7)	1.7 (3.8)	44.9 (100.0)
Ludhiana	18.7 (40.5)	23.3 (50.4)	5.3 (11.5)	-1.1 (-2.4)	46.2 (100.0)
Ferozepur	15.3 (41.8)	9.2 (25.1)	11.1 (30.3)	1.0 (2.7)	36.6 (100.0)
Amritsar	8.7 (51.2)	9.7 (57.0)	4.5 (26.5)	-5.9 (-34.7)	17.0 (100.0)
Gurdaspur	9.8 (45.4)	9.8 (45.4)	1.3 (6.0)	0.7 (3.2)	21.6 (100.0)
Bhatinda	27.4 (46.4)	15.4 (26.1)	14.1 (23.9)	2.2 (3.7)	59.1 (100.0)
Kapurthala	43.0 (488.6)	-39.2 (-445.5)	-5.9 (-67.1)	10.9 (123.9)	8.8 (100.0)
Mahendragarh	47.4 (30.7)	53.1 (34.4)	15.3 (9.9)	38.6 (25.0)	154.4 (100.0)
Patiala	14.1 (24.7)	63.8 (111.5)	-15.6 (-27.3)	-5.1 (-8.9)	57.2 (100.0)
Sangrur	26.2 (44.8)	27.5 (47.1)	10.2 (17.5)	-5.5 (-9.4)	58.4 (100.0)
Total	32.0 (53.0)	15.6 (25.8)	11.4 (18.9)	1.4 (2.3)	60.4 (100.0)

(Cont'd)

Table 37 (Cont'd)

District	Area effect	Yield effect	Crop pattern effect	Inter-action term	Percentage growth in output
			1960-1963 to 1968-1971		
Ambala	21.6 (76.1)	-2.5 (-8.8)	10.2 (36.1)	-1.0 (-3.4)	28.3 (100.0)
Hissar	-3.8 (-10.9)	24.5 (70.6)	14.0 (40.2)	0.0 (0.1)	34.7 (100.0)
Rohtak	1.8 (4.5)	26.7 (65.2)	12.3 (30.2)	0.0 (0.1)	40.9 (100.0)
Gurgaon	0.5 (40.9)	37.7 (67.6)	17.6 (31.5)	-0.0 (-0.1)	55.8 (100.0)
Karnal	16.8 (21.4)	37.1 (47.4)	22.7 (29.0)	1.8 (2.2)	78.4 (100.0)
Hoshiarpur	30.2 (47.0)	22.6 (35.0)	11.3 (17.6)	0.3 (0.4)	64.4 (100.0)
Jullundur	28.3 (34.8)	48.1 (59.1)	4.2 (5.1)	0.8 (1.0)	81.4 (100.0)
Ludhiana	57.3 (37.7)	73.1 (48.1)	15.0 (9.9)	6.6 (4.4)	152.0 (100.0)
Ferozepur	11.7 (19.0)	39.6 (64.0)	9.8 (15.8)	0.8 (1.2)	61.9 (100.0)
Amritsar	20.4 (19.1)	70.4 (65.8)	14.1 (13.2)	2.1 (1.9)	107.0 (100.0)
Gurdaspur	28.3 (30.7)	57.3 (62.1)	6.5 (7.1)	0.2 (0.2)	92.3 (100.0)
Bhatinda	12.8 (14.7)	44.7 (50.7)	28.4 (32.7)	1.7 (1.9)	86.9 (100.0)
Kapurthala	27.9 (23.7)	99.1 (84.4)	-8.3 (-7.1)	-1.2 (-1.0)	117.5 (100.0)
Mahendragarh	-0.1 (-0.2)	52.3 (145.6)	-16.3 (-45.4)	0.0 (0.0)	36.0 (100.0)
Patiala	5.3 (9.7)	41.5 (75.1)	8.1 (14.6)	0.3 (0.6)	55.2 (100.0)
Sangrur	15.7 (22.3)	35.5 (50.4)	17.7 (25.0)	1.6 (2.3)	70.5 (100.0)
Total	11.1 (16.4)	37.2 (54.6)	18.9 (27.7)	0.9 (1.3)	68.1 (100.0)

Note: The figures in parentheses indicate the percentage contribution of each element to the growth of total output.

Table 38. Pattern of land utilization in the districts of Punjab, 1951-1971

District	Net area sown			Other uncultivated land			Fallows		
	1951-1954	1960-1963	1968-1971	1951-1954	1960-1963	1968-1971	1951-1954	1960-1963	1968-1971
Hissar	66.1	93.8	92.9	10.7	0.3	0.2	23.1	5.8	7.0
Rohtak	82.0	85.5	93.6	11.6	8.6	3.7	6.3	5.8	2.8
Gurgaon	87.1	94.6	97.3	5.3	2.2	0.0	7.6	3.2	2.7
Karnal	58.8	82.6	95.7	30.2	13.1	2.2	10.9	4.4	2.1
Ambala	82.8	83.3	92.3	11.1	10.5	3.3	6.0	6.2	4.4
Hoshiarpur	84.8	88.2	94.0	8.8	6.5	3.7	6.2	5.2	2.3
Jullundur	79.9	91.9	95.6	8.2	2.0	0.0	11.7	6.6	4.4
Ludhiana	80.2	89.3	96.7	8.7	7.3	0.5	11.0	3.3	3.8
Ferozepur	77.9	86.2	88.1	7.2	5.8	3.1	14.8	8.0	8.8
Amritsar	77.0	78.5	88.1	14.2	13.0	6.2	0.7	8.7	5.4
Gurdaspur	82.8	84.2	100.0	9.0	0.0	0.0	8.2	15.9	0.0
Patiala	48.2	90.9	93.8	37.6	5.2	2.0	14.2	4.1	4.2
Sangrur	77.1	92.7	96.0	9.6	3.8	2.5	13.1	3.5	1.5
Bhatinda	85.6	95.1	99.3	2.2	1.4	0.7	12.2	3.5	0.0
Kapurthala	56.7	81.2	97.6	19.6	10.1	2.4	23.7	8.5	0.0
Mahendragarh	85.9	89.0	98.1	8.4	6.0	1.6	5.0	4.0	0.3
Total	74.7	87.3	94.0	12.9	6.7	1.8	12.4	5.9	

Source: Government of India, Directorate of Economics and Statistics, ***Indian Agricultural Statistics*** reports for relevant years.

At the district level, the phenomenal increase in the proportion of net sown area noted in Hissar was due more to reduction in fallows made possible by increase in irrigation facilities, while, in Karnal and Patiala, it was due more to the reclamation of cultivable wastes. Among the "low" growth districts, Kapurthala recorded the most notable gain in net sown area, while Jullundur, Ludhiana and Ferozepur showed moderate gains. It may be noted that, in a large number of districts, the proportion of net sown area to total arable land reached 90 per cent or more by 1961. Cultivable wastes ranging from 10 to 13 per cent were observed in Karnal, Ambala, Amritsar and Kapurthala in 1961. Fallow lands declined between 1951 and 1961 in most of the districts, with the exception of Ambala and Gurdaspur. It is interesting to observe that there was a strong inverse association between the proportion of arable land under crops in 1951-1954 and the percentage increase in net sown area between 1951-1954 and 1960-1963.

The proportion of net sown area to total arable land increased from 87 per cent in 1960-1963 to 94 per cent in 1968-1971. Culturable wastes dwindled from 6.7 to 1.8 per cent, and the proportion of land under fallows declined from 5.9 to 4.2 per cent. Data at the district level show that cultivation was reaching near-saturation limits in most parts of the region. Whatever slack existed in 1960-1963 has been almost completely taken up by 1968-1971. As observed in the preceding period, the districts which had relatively large proportions of unutilized arable land in the base years showed greater relative increase in net sown area. Thus, the proportion of net sown area to arable land in 1960-1963 was relatively low, ranging from 78 to 83 per cent in Amritsar, Kapurthala, Karnal and Ambala; by 1968-1971, it exceeded 88 per cent in Amritsar and had attained much higher levels, 92 to 98 per cent in the other three districts. There were virtually no waste lands left which could be brought under cultivation. The maximum proportion of culturable wastes to arable land, as observed in Amritsar, was 6 per cent. In several districts, this category has disappeared altogether. The proportion of land under fallow also declined in most of the districts, the maximum remaining in any district in 1968-1971 being 8.8 per cent, as against 16 per cent in 1960-1963. It is thus evident that the prospects of agricultural growth in Punjab now lie in increasing intensity of cropping and raising yields per acre.

Table 39 gives percentage changes in net and gross sown area and changes in intensity of cropping (i.e. the proportion of gross sown area to net sown area). It shows a larger increase in gross sown area (net sown area plus area sown more than once) than in net sown area. This was reflected in a rise in the intensity of cropping from 117 per cent in 1951 to 131 per cent in 1961 and 140 per cent in 1968-1971. Multiple cropping showed an increase

Table 39. Percentage change in net area sown and cropped area and intensity of cropping in the districts of Punjab, 1951-1971

District	Percentage change in net area sown		Percentage change in cropped area		Intensity of cropping[a]		
	1951-54 to 1960-63	1960-63 to 1968-71	1951-54 to 1960-63	1960-63 to 1968-71	1951-54	1960-63	1968-71
Hissar	33.1	-0.9	57.4	6.9	105.9	125.3	131.2
Rohtak	1.9	7.1	15.4	9.1	124.0	140.3	142.9
Gurgaon	7.6	2.1	21.7	4.5	109.6	124.0	128.6
Karnal	39.5	13.6	53.1	18.6	126.7	139.0	146.1
Ambala	-3.0	9.8	13.6	15.6	115.3	134.9	143.0
Hoshiarpur	-0.1	7.2	7.6	26.8	122.7	132.2	153.5
Jullundur	10.0	5.1	16.4	17.5	116.5	123.2	136.5
Ludhiana	10.2	16.0	14.1	40.8	121.7	126.0	152.8
Ferozepur	8.0	2.9	16.9	10.7	109.0	118.0	129.4
Amritsar	0.1	12.5	4.0	18.0	137.7	143.1	150.0
Gurdaspur	-8.5	20.0	4.6	25.5	118.9	135.9	142.2
Bhatinda	19.3	2.4	27.4	11.4	112.0	119.6	130.0
Kapurthala	38.4	16.3	39.9	15.6	118.2	119.5	119.0
Mahendragarh	3.1	3.1	39.0	2.6	112.0	150.9	150.1
Patiala	71.5	-4.4	86.9	0.6	118.2	128.8	135.6
Sangrur	36.3	0.9	22.4	7.9	151.9	136.5	146.0
Total	13.9	8.6	26.5	16.7	117.4	130.9	140.5

Source: Based on table 38.

[a] Ratio of cropped area to net area sown.

in all the districts, except for Sangrur. Generally, districts with "high" growth rates in 1951-1954 to 1960-1963 also recorded significant increases in the intensity of land use.

An interesting phenomenon in 1960-1963 to 1968-1971 is that the districts which showed above-median values of increase in net sown area mostly recorded even larger increase in gross sown area, which contributed to higher intensity of cropping in the terminal years. Ludhiana showed a record increase in the intensity of cropping from 126 per cent in 1960-1963 to 153 per cent in 1968-1971. In other districts - Hoshiarpur, Jullundur, and Ambala - substantial area gains in the 1960s were largely through multiple cropping, the gross sown area recording larger increase than the net sown area in these districts.

Data on irrigation are presented in tables 40 and 41. As is well known, Punjab has benefited considerably from the extension of irrigation facilities over a long period. During the periods 1951-1954 and 1960-1963, however, the increase in net as well as gross irrigated area in the state (13 per cent and 24 per cent respectively) was comparatively modest. The "high" growth districts except Hissar and Patiala, recorded below-average gains in net irrigated area. At the same time, all the "high" growth districts, except Gurgaon, had above-average increases in gross area irrigated. A significant increase in net area irrigated occurred in the "low" growth districts of Kapurthala and Ambala, although the change in the latter was partly offset by a decline in the intensity of irrigation. The changes in other districts were relatively minor. Some districts, however, experienced an actual decline in net irrigation, the notable cases being Gurdaspur in the "low" group and Gurgaon in the "high" group. Mahendragarh recorded a decline in net irrigated area but an increase of 42 per cent in gross irrigated area.

In 1951-1954, the districts with relatively low proportions of gross area irrigated to gross area sown were Hissar, Gurgaon, Ambala, Hoshiarpur and Mahendragarh. Over the period ending 1960-1963, Hissar was the only district in this group to record an appreciable gain in the proportion of gross cultivated area under irrigation. Other districts, such as Rohtak, Gurgaon, Amritsar and Karnal, suffered a perceptible decline in the ratio of gross irrigated area to gross area under cultivation, the fall in the last two districts occurring because of a relatively rapid expansion of acreage. Other districts showed only marginal variations.

The extension of net area under cultivation corresponded closely with that of net area under irrigation at the state level in 1951-1954 to 1960-1963. The association between increase in net sown area and that under irrigation was positive but not very strong, the coefficient of correlation being 0.51. Expansion of irrigation facilities, however, was closely associated with the increase of cropping intensity during this period, the coefficient of correlation between the two being 0.74. Rohtak and Gurgaon were the only important exceptions where double-cropping increased in spite of a decline in both net and gross irrigated area.

During the period 1960-1963 to 1968-1971, there was a remarkable expansion of irrigation facilities. The net irrigated area increased in the state by 34.5 per cent from 1960-1963 to 1968-1971, which is more than two and a half times that recorded in the preceding period. The increase was widely spread over all the districts. Hissar showed the smallest increase of 0.7 per cent, but it had already attained a phenomenal increase of 150 per cent during the 1950s. However, even Hissar showed a 58 per cent increase in gross area irrigated. In fact, increases in net irrigated area in several districts, remarkable in themselves and also by comparison with their respective preceding records, were excelled by even more impressive increases in gross irrigated area. This is reflected by the significant increase in the intensity of irrigation. The proportion of gross to net irrigated area rose from 129 to 149 per cent at the state level. Among the districts, the proportions ranged from 100 per cent in Hissar to 163 per cent in Mahendragarh

Table 40. Net and gross percentage change in irrigated area, and intensity of irrigation in the districts of Punjab, 1951-1971

District	Percentage change in NAI		Percentage change in GAI		Intensity of irrigation (GAI/NAI x 100)		
	1951-54 to 1960-63	1960-63 to 1968-71	1951-54 to 1960-63	1960-63- to 1968-71	1951-54	1960-63	1968-71
Hissar	151.2	0.7	140.3	56.8	104.6	100.1	155.9
Rohtak	-4.1	31.0	-10.8	36.8	130.7	121.6	127.0
Gurgaon	-23.5	126.0	-24.9	143.1	103.8	101.9	109.6
Karual	3.3	81.9	29.9	110.5	113.7	143.0	165.5
Ambala	43.9	68.3	23.9	176.5	116.1	100.0	169.3
Hoshiarpur	6.2	35.7	5.8	146.7	125.9	125.4	228.1
Jullundur	29.3	19.3	12.4	54.5	125.6	109.2	141.4
Ludhiana	-3.0	81.7	12.7	92.9	132.0	153.4	162.8
Ferozepur	9.6	20.6	18.8	39.7	100.6	118.8	137.7
Amritsar	-8.9	24.2	9.7	28.1	148.0	146.8	151.4
Gurdaspur	-14.6	28.1	-2.5	77.9	100.2	114.4	158.8
Bhatinda	2.4	59.9	36.2	53.8	105.4	140.3	134.9
Kapurthala	41.3	56.2	40.9	44.2	133.2	132.9	122.7
Mahendagarh	-7.5	147.1	42.1	95.1	100.0	163.5	121.2
Patiala	65.4	65.2	89.7	60.7	133.1	151.3	147.1
Sangrur	4.4	28.3	24.9	50.5	127.7	152.7	179.0
Total	12.9	34.5	23.6	57.8	117.4	128.5	149.1

Sources: Government of India, Directorate of Economics and Statistics, *Indian Agricultural Statistics*, for relevant years.

Note: NAI (Net Area Irrigated) represents the area irrigated from various sources, such as canals, tanks and wells;

GAI (Gross Area Irrigated) represents area irrigated under various crops, food as well as non-food.

Table 41. **Proportion of gross area irrigated to cropped area in the districts of Punjab, 1951-1971**

District	1951-1954	1960-1963	1968-1971
Hissar	21.8	33.3	49.8
Rohtak	41.5	32.1	40.2
Gurgaon	18.2	11.2	24.9
Karnal	42.7	36.3	66.6
Ambala	8.9	9.9	23.1
Hoshiarpur	13.2	12.9	36.5
Jullundur	64.7	62.5	82.1
Ludhiana	61.7	60.9	83.5
Ferozepur	65.0	66.0	83.3
Amritsar	99.0	86.0	93.4
Gurdaspur	42.8	39.9	56.6
Bhatinda	52.0	55.6	76.8
Kapurthala	65.5	66.0	82.3
Mahendagarh	4.7	4.8	9.2
Patial	43.4	44.0	70.5
Sangrur	51.8	52.8	73.7
Total	42.1	41.1	59.4

in 1960-1963, and from 110 per cent in Gurgaon to 228 per cent in Hoshiarpur in 1968-1971. Thus, expansion of irrigation facilities was generally combined with an even more intensive utilization of the irrigated areas.

An inverse association was noticed between the proportion of gross sown area with irrigation facilities in the base years (1960-1963) and the increase in gross irrigated area during the 1960s. As indicated in table 41, Gurgaon, Ambala, Hoshiarpur and Mahendragarh, which had a very low (ranging between 5 and 13 per cent) proportion of cultivated area with irrigation facilities in 1960-1963, recorded phenomenal increases of 95 to 176 per cent in the period 1961-1971 in gross irrigated area., Other districts showing comparable magnitudes were Karnal and Ludhiana, with increases of 111 per cent and 93 per cent respectively. The tendency for a greater relative increase in irrigation facilities in the districts which had a comparatively inadequate supply in the base years evidently helped to reduce the interdistrict differentials in the proportions of gross irrigated area to gross sown area. This implies a measure of equalization of the opportunities for agricultural growth. If Mahendragarh is excluded, Gurgaon and Ambala were the districts where the proportions remained low in the terminal years in spite of the remarkable rates of expansion (due directly to a very low base). Omitting these three districts, the observed range, from 13 to 86 per cent in 1960-1963, was reduced to 37 to 93 per cent in 1968-1971.

There is a measure of positive, though not very strong, association between growth of agriculture and expansion of irrigation facilities. Among the districts in the "high" output growth group, Karnal, Ludhiana, Bhatinda and Karputhala recorded above-median increases in net irrigated area, but increases in other "high" output growth districts were below the state average. Amritsar sustained "high" agricultural growth with small increases in irrigated area, but it already had a proportion of gross area irrigated to gross area sown as high as 86 per cent in 1960-1963. Outside the "high" output growth group, Ambala was the only district which showed an above-average increase in net area under crops; it also recorded an increase in gross irrigated area of the order of 177 per cent.

There was no systematic association between extension of irrigated area and extension of cropped area. The latter fell far short of the former in most districts, suggesting that a good part of additional irrigation was used for supplying more water to the existing area, the scope for further extension of cropped acreage being limited. What was interesting to observe, however, was the relationship between the extent of irrigation facilities as measured by the ratio of gross irrigated area to gross sown area and the intensity of cropping (GAS/NAS). Of the eight districts in the "high" output growth group, Karnal, Ludhiana, Amritsar, Gurdaspur and Sangrur showed above-median values of cropping irtensity as well as relatively high intensity of irrigation. The association between irrigation and output per acre is even stronger, as will be evident from the analysis of production function prèsented in a later chapter.

B. ORISSA

1. Aggregate growth rates

Table 42 gives data on growth of agriculture in Orissa and its districts arranged in order of increase in output. Total output increased at an average rate of 4.9 per cent per annum in the period 1951-1954 to 1960-1963 and 3 per cent per annum in the period ending in 1968-1971. The extension of area under crops rose from 1 per cent per annum in the 1950s to 1.8 per cent in the 1960s, but it was more than offset by the drop in productivity increase from 3.9 to 1.4 per cent per annum. Orissa was taking advantage of new seed-water-fertilizer technology, but it recorded no improvement because of limited success with the new varieties of rice. As in Punjab, significant interdistrict variations in the growth of output in Orissa were observed.

Table 42. Average annual rates of growth in output, area and productivity in the districts of Orissa, 1951-1971

1951-1953 to 1960-1963				1960-1963 to 1968-1971			
High output growth districts	Output	Area	Productivity	High output growth districts	Output	Area	Productivity
Kalahandi	9.9	4.2 (High)	5.4 (High)	Ganjam	7.1	6.9 (High)	0.1 (Low)
Ganjam	9.0	1.6 (High)	7.3 (High)	Baudh Khondmals	6.2	0.9 (Low)	5.1 (High)
Dhenkanal	7.7	2.0 (High)	5.6 (High)	Cuttack	5.7	2.6 (High)	3.1 (High)
Bolangir	7.6	2.5 (High)	5.0 (High)	Balasore	4.0	1.9 (High)	2.1 (High)
Puri	4.9	1.1 (High)	3.8 (High)	Sambalpur	3.7	0.9 (Low)	2.7 (High)
Cuttack	4.7	0.3 (Low)	4.4 (High)	Dhenkanal	3.5	1.1 (Low)	2.4 (High)
Orissa average	4.9	1.0	3.9	Orissa average	3.2	1.8	1.4
Low output growth districts	Output	Area	Productivity	Low output growth districts	Output	Area	Productivity
Sambalpur	4.1	0.9 (High)	3.2 (Low)	Puri	3.1	0.5 (Low)	2.6 (High)
Sundergarh	4.0	1.3 (High)	2.6 (Low)	Mayurbhanj	2.6	1.8 (High)	0.8 (Low)
Balasore	3.9	-0.5 (Low)	4.5 (High)	Koraput	2.2	2.6 (High)	-0.4 (Low)
Keonjhar	3.6	-1.5 (Low)	5.1 (High)	Keonjhar	0.9	0.5 (Low)	0.4 (Low)
Mayurbhanj	3.5	-1.0 (Low)	4.5 (High)	Bolangir	0.8	0.4 (Low)	0.4 (Low)
Koraput	3.3	0.9 (High)	2.3 (Low)	Kalahandi	1.1	0.5 (Low)	-1.6 (Low)
Baudh Khondmals	-3.4	-4.1 (Low)	0.7 (Low)	Sundergarh	-4.3	-2.5 (Low)	-1.9 (Low)

Sources: Government of Orissa. *Season and Crop Reports*. This is an annual publication giving statistics of area and production of crops at district level. The data utilized in this table are obtained from these reports for relevant years.

Note: Districts are arranged in descending order of the rate of growth of output.

In 1951-1961, in the "high" growth group, Kalahandi, Ganjam, Dhenkanal and Bolangir were very close to each other in terms of growth of output, the annual rate of increase ranging from 7.6 to 9.9 per cent. Puri and Cuttack were close to the state average. The range of variation in the "low" output growth districts was considerably smaller, the upper and the lower limits in the annual rates of output growth being 4.1 per cent and 3.3 per cent respectively, except for Baudh Khondmals which showed a decline in output of 3.4 per cent per annum.

As already observed, area gains were much less important in contributing to agricultural growth in Orissa than in Punjab during 1951-1961, the highest rate per annum being only 4.2 per cent in Kalahandi as against 8.8 per cent observed in Patiala in Punjab. In the other "high" growth districts of Orissa it was very much lower, ranging from 0.3 to 2.5 per cent. In the "low" group, several districts suffered an absolute decline in cropped area, the largest decline (4.1 per cent) being in Baudh Khondmals.

Unlike Punjab, interdistrict differences in rupee value of output per hectare lay within a narrow range in Orissa; the lowest (Rs 83.5) was recorded by Ganjam and the highest, (about Rs 132) by Koraput. The "high" growth districts in Orissa had generally lower productivity levels than the state average in the base period. The relationship between the initial productivity levels and their rise over time was significantly inverse, the coefficient of correlation being -0.74. This suggests a general tendency towards more effective exploitation of the unused productivity potential in Orissa, as in Punjab.

Ganjam, which ranked first in order of output growth in the 1960s, occupied second position in the preceding period when it actually recorded an even higher growth rate of 9 per cent per annum. Baudh Khondmals, which ranged second in the 1960s, was at the bottom in the earlier period, having recorded an annual decrease of 3.4 per cent. The high growth rate in the current period was partly attributable to recovering lost ground. Ganjam, Cuttack and Dhenkanal were the only districts in the "high" growth group in both the 1950s and the 1960s. With the exception of Cuttack, all the districts in the "high" growth group in the 1960s showed lower growth rates in the preceding period. All the districts in the "low" growth group showed an even greater relative decline. Kalahandi and Sundergarh reported absolute declines at the rate of 1.1 per cent and 4.3 per cent per annum respectively.

In 1961-1971 there was no relationship between area gain and output growth. Increase in area accounted for almost the entire growth in Ganjam and about half in Cuttack and Balasore. In Baudh Khondmals, Sambalpur and Dhenkanal, area increase played a relatively minor role. In the "low" growth group, Koraput and Mayurbhanj recorded moderate gains in area. Other districts showed nominal increases. Sundergarh recorded an absolute decline of 2.5 per cent per annum.

Productivity change showed a close association with over-all agricultural growth. Except for Ganjam, the annual rate of increase in productivity was relatively high in all the "high" growth districts and accounted for the major part of their output growth. Puri, in the "low" growth group, showed a relatively high increase in productivity; all other "low" districts registered either nominal increases or absolute declines.

While, at the state level, during 1961-1971 increase in area appeared to be a more important factor than productivity change in output growth, this was not so in all but one of the "high" growth districts. This was because increase in area was concentrated in a few districts. Compared with the preceding period, however, absolute gains in productivity were lower in all the districts except Baudh Khondmals.

Unlike the preceding period, there is no systematic association between the base level productivity and the increase over time. Baudh Khondmals, which had the lowest productivity in 1960-1963, showed the maximum gain, but other districts with relatively low bases did not show any compensating variations. In fact, the range of variations in output per hectare actually increased over time. Excluding Baudh Khondmals, it varied between Rs 132 and Rs 165 in 1960-1963. In 1968-1971, the range was as wide as Rs 123 to Rs 211.

2. **Rates of growth of different crops**

Data on the growth of output and area under various crops are presented in table 2 of annex III. The crop pattern in Orissa suggests a predominantly subsistence type of farming, with a few food crops covering the bulk of the cultivated area. Rice alone accounted for two thirds or more of total area as well as of aggregate output.

The output of rice grew at an impressive rate of 5.7 per cent per annum in the 1950s, mainly on account of increase in productivity. Other crops which recorded relatively high rates of growth were jowar, small millets and potatoes among food crops, and tobacco in the non-food group. Food crops, as a whole, recorded an annual growth of 5.3 per cent, mainly due to rise in output per acre. Non-food crops grew by 1.7 per cent, the lower gowth rate being largely due to lower productivity. The area under food crops increased by 1.1 per cent per annum, while that under non-food crops experienced a slight decline.

The trends at the district level are fairly divergent. The interdistrict differences in the growth of food output are roughly of the same magnitude as those in aggregate output. The growth of non-food crops was significant, but was generally lower than that of food crops in most of the "high" growth districts; Dhenkanal, however, showed an absolute decline. Most of the "low" growth districts, on the other hand, recorded only nominal increases or suffered absolute declines. In Baudh Khondmals and Keonjhar, the fall in non-food output was 15 per cent and 7 per cent per annum respectively. Koraput was the only "low" growth district where the annual increase in non-food crops was as high as 6.4 per cent. This was largely due to rise in productivity. However, Kalahandi and Puri in the "high" group and Mayurbhanj in the "low" group also showed some gains in area under non-food crops.

Since rice was the dominant crop in nearly all districts, the growth of its output replicated the trend of aggregate output. Output of rice per acre showed a rise in all the districts except Baudh Khondmals; on the other hand, the area under rice declined in five districts. Output of ragi, another important food crop in Orissa, also showed an increase in all but one of the "high" growth districts, although its growth seldom exceeded over-all growth. Sambalpur in the "low" group, however, recorded an increase of 8 per cent in the output of ragi, which was impressive in relation to its over-all growth. Area gains under this crop were noted only in Ganjam, Kalahandi, Puri, Sambalpur and Mayurbhanj. The output of small millets recorded a phenomenal growth of 35 per cent in Dhenkanal, although this crop either remained static or decreased in 7 of the 13 districts; the area under millets increased in Dhenkenal by 29 per cent. Bolangir, Koraput and Sambalpur also showed significant growth in small millets, mainly due to rise in productivity. Significant increases in the output of pulses was noted in Bolangir, Cuttack and Kalahandi among the "high" growth districts, and Sundergarh in the "low" growth group; expansion of area under this crop was particularly conscpicuous in the first two of these districts and increase of productivity in the other two.

Among the non-food crops, the output of oilseeds recorded impressive growth only in Kalahandi and Mayurbhanj. Fibre crops (cotton, jute and mesta) recorded significant increases of 21 per cent and 16 per cent in Puri and Dhenkanal respectively; the highest area increase under these crops was 14 per cent in Puri. The decline in area under fibre crops in Dhenkanal makes the output and productivity figures rather suspect. Growth of the output of fibre crops is also relatively high in Baudh Khondmals, Koraput, and Sambalpur, but increase in area played a major role only in Sambalpur. Rapid growth in the output of sugarcane was reported only in Balasore, Bolangir, and Kalahandi. In view of the 5 per cent decrease in output and 14 per cent decline in productivity, the increase of 9 per eent in area under sugarcane in Baudh Khondmals is, indeed surprising. The erratic trends in output and area noted in some cases in Orissa should be interpreted with caution, considering the limitations of agricultural data in the state, as indicated earlier.

During the 1960s, the growth rate of output of rice was substantially lower (1.8 per cent) than the increase in total output (3.2 per cent). The gap is almost equally shared by area and productivity change. Jowar, maize, ragi, wheat and small millets recorded high rates of growth, ranging from 10 to 20 per cent, but their share in the total output was too low to make a sizable impact on the over-all growth rate of food crops. Among the non-food crops, oilseeds were of some consequence in the base period and showed an increase of 10 per cent per annum, mainly due to increase in productivity. Sugar and tobacco showed increases of 8 per cent and 7 per cent respectively. The relative trends in food and non-food crops in the 1960s were in sharp contrast to those in the preceding period, the respective rates of growth being 2.5 per cent and 8.5 per cent per annum, as against 5.3 per cent and 1.7 per cent in the 1950s.

Rice, an overwhelmingly important crop in each district, generally showed relatively lower rates of growth in the "low" and the "high" output growth groups alike in 1961-1971 than in the previous period. Thus, the annual increase in rice was only 2 per cent in Ganjam as compared with its over-all growth rate of 7 per cent. The gap in the relative growth rates of rice was not so marked in the other districts. In Kalahandi, Keonjhar, Koraput and Sundergarh, there were absolute declines in the output of rice.

The phenomenal growth in the output of jowar was of little significance since its contribution to total output was negligible in the base period. Maize showed moderate increases of 4 per cent to 7 per cent per annum in Cuttack, Dhenkanal and Sundergarh, and higher rates ranging from 12 to 51 per cent in other districts. Ragi recorded high rates ranging from 13 to 57 per cent in several districts. Wheat has been introduced in comparatively recent years, but its annual rate of growth was very impressive in Balasore, Dhenkanal, Keonjhar Mayurbhanj, Baudh Khondmals, Puri, Sambalpur and Sundergarh, varying from 20 to 40 per cent. Small millets again showed large increases of between 20 and 103 per cent in Puri, Mayurbhanj, Koraput, Kalahandi and Ganjam. Pulses showed divergent trends, with annual increases varying from 12 to 26 per cent in Balasore, Dhenkanal, Ganjam, Keonjhar and Mayurbhanj, and absolute decreases from 26 to 13 per cent in Sundergarh, Bolangir and Kalahandi.

Among the non-food crops, oilseeds recorded striking rates of increase in most of the "high" growth districts and in some of the "low" group as well. Bolangir, Kalahandi and Sundergarh, in the "low" group, showed absolute decline. Fibres showed relatively high rates of growth in only Dhenkanal, Ganjam and Baudh Khondmals of the six "high" growth districts. On the other hand, Kalahandi and Sundergarh, which showed negative over-all change in agricultural output, showed annual gains in fibres of 37 per cent and 20 per cent respectively. Keonjhar and Baudh Khondmals registered increases in tobacco of 34 per cent and 43 per cent respectively, while Cuttack and Ganjam showed annual decreases of 9 per cent and 8 per cent respectively. Similarly, Ganjam, Baudh Khondmals, Cuttack and Puri recorded significant increases in the output of sugarcane ranging from 16 to 26 per cent, but there were also districts which showed an absolute decline in its output.

As at the state level, the aggregate output of non-food crops showed a more rapid increase than that of food crops in most districts. The growth of non-food crops was notably high in the districts in the "high" growth group, ranging from 10 to 20 per cent, with two exceptions. There is no uniform trend in the relative contribution of area and productivity change to the growth of output in either category.

3. Shifts in crop pattern

The shares of the first five crops, ranked in order of their respective contributions to total output and area, are presented in tables 43 and 44, and the respective shares of the food and the non-food groups in total output are presented in table 45.

The distribution of output and area among different crops indicates the extent of the subsistence nature of farming in Orissa. Between 1951 and 1961 food crops comprised almost 90 per cent of the total agricultural output in Orissa as against about 70 per cent in Punjab. The overwhelming predominances of rice was an equally striking feature of agriculture in Orissa. Such a unique pattern may perhaps be attributed to the soil and rainfall conditions in the state.

Table 43. Average shares of the first five crops in total output in the districts of Orissa, 1951-1971

							Total
Orissa	1951-1954	Rice 72.6	Pulses 11.7	Oilseeds 3.9	Sugarcane 3.6	Fibre crops 3.2	95.0
	1960-1963	Rice 77.7	Pulses 10.5	Oilseeds 3.1	Sugarcane 2.4	Fibre crops 1.8	95.5
	1968-1971	Rice 69.9	Pulses 7.6	Oilseeds 4.9	Potatoes 4.2	Sugarcane 3.5	90.1
Cambalpur	1951-1954	Rice 83.5	Pulses 7.2	Sugarcane 3.5	Oilseeds 3.2	Tobacco 1.0	98.4
	1961-1963	Rice 85.2	Pulses 6.5	Oilseeds 3.0	Sugarcane 2.1	Millets 1.0	97.8
	1968-1971	Rice 82.7	Oilseeds 5.4	Sugarcane 3.7	Potatoes 2.3	Pulses 2.1	96.2
Sundergarh	1951-1954	Rice 76.6	Pulses 14.8	Oilseeds 4.9	Sugarcane 1.7	Maize 0.5	98.5
	1960-1963	Rice 69.1	Pulses 24.0	Oilseeds 3.9	Sugarcane 1.3	Maize and potatoes 0.5	98.8
	1968-1971	Rice 82.0	Potatoes 3.2	Pulses 3.0	Oilseeds 2.9	Sugarcane 2.8	93.9
Keonjhar	1951-1954	Rice 84.1	Fibre crops 5.9	Oilseeds 4.1	Pulses 2.5	Sugarcane 1.9	98.5
	1960-1963	Rice 93.3	Fibre crops 2.1	Oilseeds 1.4	Sugarcane 1.2	Pulses 1.0	99.0
	1968-1971	Rice 82.2	Pulses 4.1	Oilseeds 3.8	Fibre crops 2.9	Maize 2.4	95.4

(Cont'd)

Table 43 (Cont'd)

							Total
Mayurbhanj	1951-1954	Rice 94.7	Sugarcane 1.7	Fibre crops 0.9	Pulses 0.8	Tobacco 0.6	98.7
	1960-1963	Rice 96.1	Oilseeds 1.1	Fibre crops 0.9	Pulses 0.6	Sugarcane 0.5	99.2
	1968-1971	Rice 85.0	Oilseeds 3.9	Pulses 3.4	Potatoes 1.8	Maize 1.4	95.5
Balasore	1951-1954	Rice 89.9	Fibre crops 7.2	Pulses 1.8	Sugarcane 0.7	Oilseeds 0.4	100.0
	1960-1963	Rice 94.4	Fibre crops 3.2	Pulses 1.1	Sugarcane 1.0	Oilseeds 0.1	99.8
	1968-1971	Rice 89.1	Pulses 4.1	Fibre crops 3.0	Chillies 1.5	Sugarcane 0.8	98.5
Cuttack	1951-1954	Rice 59.0	Pulses 15.1	Fibre crops 13.4	Potatoes 2.7	Sugarcane 2.6	92.8
	1960-1963	Rice 64.8	Pulses 15.9	Fibre crops 11.2	Potatoes 2.5	Oilseeds 2.1	96.5
	1968-1971	Rice 61.2	Potatoes 10.8	Pulses 10.4	Fibre Crops 8.0	Sugarcane 3.9	94.3
Dhenkanal	1951-1954	Rice 66.3	Pulses 13.6	Sugarcane 9.2	Oilseeds 8.5	Tobacco 0.7	98.3
	1960-1963	Rice 88.6	Pulses 3.3	Oilseeds 2.6	Sugarcane 2.5	Potatoes 0.9	97.9
	1968-1971	Rice 75.0	Oilseeds 8.3	Pulses 6.1	Sugarcane 3.8	Potatoes 2.4	95.6
Baudh Khondmals	1951-1954	Rice 68.6	Oilseeds 13.7	Pulses 11.7	Millets 2.3	Tobacco 1.6	97.9
	1960-1963	Rice 74.6	Pulses 16.5	Oilseeds 3.6	Millets 2.8	Chillies 0.6	98.1
	1968-1971	Rice 71.3	Pulses 5.2	Maize 4.3	Oilseeds 4.1	Tobacco 4.1	89.0
Bolangir	1951-1954	Rice 66.2	Pulses 14.1	Oilseeds 8.8	Sugarcane 4.4	Millets 2.5	96.0
	1960-1963	Rice 65.0	Pulses 19.0	Oilseeds 6.0	Sugarcane 3.9	Millets 2.8	96.7
	1968-1971	Rice 75.6	Pulses 6.2	Oilseeds 5.0	Sugarcane 4.0	Potatoes 2.4	93.2

(Cont'd)

Table 43 (Cont'd)

							Total
Kalahandi	1951-1954	Rice 62.7	Pulses 16.5	Oilseeds 7.2	Sugarcane 4.9	Tobacco 3.8	95.1
	1960-1963	Rice 59.4	Pulses 19.6	Oilseeds 9.6	Sugarcane 5.2	Ragi 2.1	95.9
	1968-1971	Rice 61.6	Oilseeds 7.3	Pulses 7.0	Millets 5.3	Sugarcane 4.5	85.7
Koraput	1951-1954	Rice 65.7	Pulses 10.5	Ragi 9.0	Sugarcane 8.7	Oilseeds 2.2	96.1
	1960-1963	Rice 76.5	Tobacco 9.1	Sugarcane 4.8	Pulses 3.2	Oilseeds 2.8	96.4
	1968-1971	Rice 53.1	Tobacco 13.8	Ragi 7.6	Oilseeds 6.1	Sugarcane 4.6	85.2
Ganjam	1951-1954	Rice 68.7	Pulses 18.6	Oilseeds 4.6	Ragi 2.9	Sugarcane 1.5	96.3
	1960-1963	Rice 86.1	Pulses 4.9	Ragi 2.8	Oilseeds 2.7	Sugarcane 0.9	97.4
	1968-1971	Rice 58.5	Pulses 16.9	Oilseeds 6.8	Ragi 6.5	Chillies 4.3	93.0
Puri	1951-1954	Rice 71.8	Pulses 21.8	Sugarcane 3.0	Oilseeds 1.4	Ragi 0.7	98.7
	1960-1963	Rice 79.2	Pulses 15.7	Sugarcane 2.1	Oilseeds 0.8	Fibre crops 0.7	98.5
	1968-1971	Rice 67.6	Pulses 13.0	Potatoes 7.2	Sugarcane 5.6	Oilseeds 3.6	97.0

Source: Same as table 42.

Table 44. Average shares of the first five crops in gross sown area in the districts of Orissa, 1951–1971

							Total
Orissa	1951-1954	Rice 79.6	Pulses 9.3	Oilseeds 4.5	Ragi 2.5	Fibre crops 1.3	97.2
	1960-1963	Rice 77.4	Pulses 13.4	Oilseeds 4.0	Ragi 1.3	Fibre crops 1.2	97.3
	1968-1971	Rice 74.5	Pulses 10.7	Oilseeds 4.7	Millets 2.9	Ragi 2.6	95.4
Sambalpur	1951-1954	Rice 87.5	Pulses 5.4	Oilseeds 3.6	Millets 2.1	Sugarcane 0.6	99.2
	1960-1963	Rice 83.6	Pulses 10.0	Oilseeds 2.8	Millets 1.7	Sugarcane 0.6	98.7
	1968-1971	Rice 88.1	Oilseeds 4.1	Pulses 3.0	Millets 1.7	Potatoes 0.8	97.7
Sundergarh	1951-1954	Rice 77.2	Pulses 15.3	Oilseeds 4.7	Maize 0.9	Fibre crops 0.8	98.9
	1960-1963	Rice 78.6	Pulses 14.7	Oilseeds 4.1	Fibre Crops 0.8	Maize 0.7	98.9
	1968-1971	Rice 84.2	Pulses 5.3	Millets 3.0	Oilseeds 2.7	Maize 1.1	96.3
Keonjhar	1951-1954	Rice 91.8	Oilseeds 2.9	Fibre crops 2.1	Pulses 1.9	Maize 0.6	99.3
	1960-1963	Rice 90.5	Pulses 4.4	Oilseeds 1.7	Maize 1.3	Fibre crops 1.0	98.9
	1968-1971	Rice 84.9	Pulses 4.5	Maize 3.3	Oilseeds 3.2	Fibre crops 1.5	97.4
Mayurbhanj	1951-1954	Rice 97.4	Pulses and oilseeds 0.7	Fibre crops 0.4	Maize 0.3	Sugarcane 0.2	99.0
	1960-1963	Rice 95.5	Pulses 1.8	Oilseeds 1.1	Fibre crops 0.5	Maize 0.4	99.3
	1968-1971	Rice 84.6	Pulses 5.9	Oilseeds 3.8	Millets 1.5	Maize 1.5	97.3
Balasore	1951-1954	Rice 96.5	Fibre crops 2.1	Pulses 1.1	Sugarcane 0.2	Oilseeds 0.1	100.0
	1960-1963	Rice 97.5	Fibre crops 1.2	Pulses 1.0	Sugarcane 0.2	Oilseeds 0.1	100.0
	1968-1971	Rice 90.9	Pulses 5.6	Fibre crops 1.3	Oilseeds 0.7	Ragi 0.5	99.0
Cuttack	1951-1954	Rice 78.1	Pulses 10.7	Fibre crops 5.2	Oilseeds 2.6	Ragi 0.9	97.5
	1960-1963	Rice 72.5	Pulses 16.6	Fibre crops 5.5	Oilseeds 2.4	Potatoes 1.1	98.1
	1968-1971	Rice 72.5	Pulses 16.0	Fibre crops 4.2	Oilseeds 2.6	Potatoes 1.0	96.3

(Cont'd)

Table 44 (Cont'd)

							Total
Dhenkanal	1951-1954	Rice 73.0	Pulses 12.5	Oilseeds 10.7	Fibre crops 1.2	Sugarcane 0.9	98.3
	1960-1963	Rice 79.9	Pulses 10.7	Oilseeds 6.0	Fibre crops and millets 0.7	Sugarcane 0.6	97.9
	1968-1971	Rice 78.1	Pulses 8.9	Oilseeds 7.8	Millets 1.3	Maize 0.9	97.0
Bolangir	1951-1954	Rice 67.3	Oilseeds 13.0	Pulses 11.4	Millets 4.6	Ragi 1.5	97.8
	1960-1963	Rice 65.0	Pulses 18.5	Oilseeds 9.3	Millets 3.7	Ragi 1.2	97.7
	1968-1971	Rice 71.8	Pulses 9.8	Millets 7.0	Oilseeds 5.7	Ragi 1.5	95.8
Baudh Khondmals	1951-1954	Rice 61.7	Pulses 15.3	Oilseeds 11.4	Millets 7.4	Maize 2.1	97.9
	1960-1963	Rice 65.6	Pulses 16.5	Oilseeds 6.6	Millets 5.8	Maize 2.8	97.3
	1968-1971	Rice 55.5	Pulses 12.0	Oilseeds 9.7	Millets 9.1	Maize 7.2	93.5
Kalahandi	1951-1954	Rice 68.5	Pulses 13.0	Oilseeds 9.5	Ragi 4.7	Jowar 0.9	96.6
	1960-1963	Rice 67.3	Pulses 13.6	Oilseeds 11.6	Ragi 3.9	Maize 1.1	97.5
	1968-1971	Rice 65.8	Millets 9.8	Pulses 9.0	Oilseeds 7.6	Ragi 2.5	94.7
Koraput	1951-1954	Rice 69.8	Ragi 17.5	Oilseeds 4.0	Pulses 3.7	Sugarcane 1.1	96.1
	1960-1963	Rice 83.3	Oilseeds 4.6	Pulses 3.4	Ragi 2.7	Sugarcane and maize 1.1	95.1
	1968-1971	Rice 60.2	Ragi 10.8	Millets 8.1	Pulses 5.9	Oilseeds 5.9	90.9
Ganjam	1951-1954	Rice 76.6	Pulses 12.2	Oilseeds 5.0	Ragi 4.0	Maize 0.6	98.4
	1960-1963	Rice 81.1	Pulses 7.8	Ragi 5.9	Oilseeds 3.7	Fibre crops 0.5	99.0
	1968-1971	Rice 61.9	Pulses 22.2	Ragi 6.4	Oilseeds 5.6	Chilles 1.1	97.2
Puri	1951-1954	Rice 76.1	Pulses 20.1	Oilseeds 1.7	Ragi 1.0	Sugarcane 0.5	99.4
	1960-1963	Rice 68.8	Pulses 27.2	Oilseeds 1.6	Ragi 1.1	Sugarcane and fibre crops 0.4	99.1
	1968-1971	Rice 70.9	Pulses 19.2	Oilseeds 4.1	Ragi 1.8	Sugarcane 1.0	97.0

Table 45. Percentage share of food and non-food crops in total output and area in the districts of Orissa, 1951-1971

District	Food crops				Non-food crops			
	Share in output		Share in area		Share in output		Share in area	
	1951-53	1960-63	1951-53	1960-63	1951-53	1960-63	1951-53	1960-63
Sambalpur	93.5	91.5	95.9	95.2	7.1	8.3	4.0	4.7
Sundergarh	94.5	92.6	94.7	94.2	5.5	6.7	5.2	5.7
Keonjhar	94.9	87.3	96.7	94.5	4.7	12.0	3.0	5.3
Mayurbhanj	97.1	95.7	98.0	98.4	2.7	3.7	1.9	1.4
Balasore	95.6	91.7	98.5	97.6	4.4	8.3	1.5	2.4
Cuttack	83.6	77.8	91.2	91.0	16.4	22.2	8.8	9.0
Dhenkanal	93.5	80.9	92.3	87.0	6.5	19.1	7.5	13.0
Baudh Khondmals	95.0	84.0	92.1	87.8	5.0	16.0	7.9	12.2
Bolangir	88.1	84.6	89.1	85.5	11.9	15.4	10.9	14.5
Kalahandi	83.9	83.6	87.3	88.3	16.1	16.3	12.6	10.9
Koraput	82.5	86.7	93.1	94.1	17.4	13.3	7.0	5.9
Ganjam	94.2	90.7	95.3	93.8	5.8	9.3	4.7	6.2
Puri	96.2	95.2	97.7	97.8	3.6	4.6	2.4	2.3
Total	90.4	87.5	94.1	93.4	9.6	12.5	5.9	9.9

District	Food crops				Non-food crops			
	Share in output		Share in area		Share in output		Share in area	
	1960-63	1968-71	1960-63	1968-71	1960-63	1968-71	1960-63	1968-71
Sambalpur	91.5	89.1	95.2	94.3	8.3	10.9	4.7	5.5
Sundergarh	92.6	92.0	94.2	96.4	6.7	8.0	5.7	3.9
Keonjhar	87.3	91.7	94.5	94.3	12.0	8.7	5.3	5.2
Mayurbhanj	95.7	92.8	98.4	93.9	3.7	7.0	1.4	4.8
Balasore	91.7	94.1	97.6	97.2	8.3	5.9	2.4	2.6
Cuttack	77.8	83.1	91.0	92.0	22.2	16.9	9.0	7.8
Dhenkanal	80.9	85.1	87.0	90.3	19.1	15.0	13.0	9.8
Baudh Khondmals	84.0	89.6	87.8	93.8	16.0	10.3	12.2	5.7
Bolangir	84.6	87.3	85.5	91.8	15.4	12.5	14.5	8.2
Kalahandi	83.6	82.1	88.3	89.9	16.3	17.9	10.9	10.1
Koraput	86.7	73.0	94.1	90.9	13.3	27.1	5.9	9.2
Ganjam	90.7	84.2	93.8	92.2	9.3	15.5	6.2	7.9
Puri	95.[illegible]	89.6	97.8	93.8	4.6	10.3	2.3	5.7
Total	87.5	85.9	93.4	92.8	12.5	14.2	9.9	7.2

Source: Government of India, Directorate of Economics and Statistics, *Estimates of Area and Production ofPrincipal Crops in India,* reports for relevant years.

The changes in the crop pattern between 1951-1954 and 1960-1963 in Orissa were relatively minor. While food output showed a small decline in Punjab, it showed a small relative increase in Orissa. The share of rice in output increased from 73 to 78 per cent, but, because of the rise in its productivity, its share in area declined from 80 to 77 per cent. Pulses showed an opposite trend; their share in value declined marginally from 12 to 11 per cent, while the area increased from 9 to 13 per cent. In terms of value, the three other major crops were oilseeds, sugarcane and fibre crops. Their shares, however, were not large, being less than 4 per cent in 1951-1954 and still smaller in 1960-1963. In terms of area, ragi, a relatively low-yielding crop, replaced sugarcane, while the position of the other crops remained unaltered.

The district patterns showed but small variations. Food crops were dominant everywhere, their share in output as well as in area being generally lower in the "high" growth districts than in the "low" growth group. The share of output of food crops increased during the period 1951-1954 to 1960-1963, irrespective of the class of districts, with the sole exception of Koraput. While rice was the dominant crop, its relative importance showed significant interdistrict variations. In 1951-1954, its share in output ranged from 59 to 72 per cent in the "high" growth districts; while, in the "low" growth districts, its share ranged from 90 to 95 per cent in the districts of Balasore and Mayurbhanj. Between 1951-1954 and 1960-1963, the trend was one of increase in all districts except Bolangir, Kalahandi and Sundergarh. Over the same period, the area allocated to rice declined slightly at the state level and in 7 of the 13 districts.

Pulses were next to rice in share of output, but the maximum in 1951-1954 was 22 per cent in Puri, and most other districts averaged between 10 and 18 per cent. In Sambalpur, their share of output was 7 per cent and, in Balasore, Keonjhar and Mayurbhanj, it was less than 3 per cent. While some districts recorded a relative increase in the output of pulses between 1951-1954 and 1960-1963, others like Dhenkanal and Ganjam showed quite large decreases even though the area under pulses declined only marginally in these districts. The figures thus appear somewhat suspect. Other crops of importance were fibres in Balasore, Cuttack and Keonjhar, but their relative importance declined in these districts between 1951-1954 and 1960-1963. The relative output of oilseeds was substantial in Bolangir, Baudh Khondmals, Dhenkanal and Kalahandi in 1951-1954. However, except in Kalahandi, this group of crops declined between 1951-1954 and 1960-1963. Sugarcane was an important crop mainly in four districts: Bolangir, Dhenkanal, Kalahandi and Koraput. Its share registered a marginal increase between 1951-1954 and 1960-1963 only in Kalahandi; in all other districts there was a marked decline. Thus, there was a general trend for a relative decline in the importance of non-food crops in all the districts. Tobacco was the major exception in Koraput, accounting for 9 per cent of the total output in 1960-1963 as against only 1.8 per cent in 1951-1954, but it did not appear among the first five crops in Koraput in order of area.

Agriculture in Orissa continued to be limited to a few crops in the 1960s as well. The five crops, rice, pulses, oilseeds, fibres and sugarcane accounted for 96 per cent of the total output in 1960-1963. In 1968-1971, although there was some diversification, these five crops accounted for 90 per cent of the agricultural output. Rice and pulses remained the two major crops, but their respective proportions declined from 78 per cent and 11 per cent in 1960-1963 to 70 per cent and 8 per cent in 1968-1971 respectively. Potatoes became an important crop and oilseeds and sugarcane registered marginal gains of 1.9 per cent and 1.4 per cent respectively. The changes in the allocative pattern of land were also small. There was a small drop in the share of rice: about 5 per cent. On the other hand, inferior cereals like ragi and small millets were allotted a larger area in 1968-1971. The magnitudes involved were too small to cause any major shift in the crop pattern in the state.

The same pattern of most of the agricultural output being limited to five crops was observed at the district level in 1960-1963. Between 1960-1963 and 1968-1971, the combined proportion of the first five crops declined slightly, but the extent of change was limited, except in Kalahandi, Koraput and Baudh Khondmals which recorded a decline of about 10 per cent. All districts, except Bolangir, Kalahandi and Sundergarh, showed a declining trend in the relative significance of rice. The decline was more marked in some districts than in others, but the extent of change showed no association with over-all rates of agricultural growth. However, there was a tendency toward a greater decline in output than in area, implying a relative decline in the productivity of rice during the period. Pulses, next in importance to rice, also recorded a relative decline, particularly in Bolangir, Cuttack, Kalahandi, Baudh Khondmals and Sundergarh. Again, the decline was greater in the share of the crop in output than in area, with the implication of a decline in productivity. Some districts showed a minor relative increase in the significance of pulses. Ganjam recorded a significant gain; the share of pulses in output rose from 5 per cent in 1960-1963 to 17 per cent in 1968-1971. In several districts, the allocative pattern of farm land showed a very curious tendency towards the substitution of low-value cereals like small millets, ragi and maize for rice. This is in sharp contrast to the trend in Punjab, where wheat recorded significant gains at the expense of gram.

Among the crops other than cereals and pulses, the relative share of potatoes increased in Bolangir, Cuttack, Sambalpur and Sundergarh; of sugarcane in Cuttack, Dhenkanal and Puri; and of oilseeds in Dhenkanal, Ganjam, Keonjhar, Puri and Sambalpur. Tobacco was an important crop in Koraput and Baudh Khondmals and its relative importance increased in the years 1960-1963 to 1968-1971.

The nature of shifts in the crop pattern is broadly summed up in terms of the conventional food and non-food classification, as may be easily seen from table 45.

A trend towards increase in the relative importance of non-food crops may be noted. At the state level, their share in output increased by 5 per cent. The gains were largest in Ganjam and Koraput: about 10 per cent in each. In Bolangir, Cuttack and Kala-

Table 46. Pattern of land utilization in the districts of Orissa, 1951-1971

District	Net sown area			Fallows			Culturable waste		
	1951-54	1960-63	1968-71	1951-54	1960-63	1968-71	1951-54	1960-63	1968-71
Sambalpur	48.3	61.7	82.9	5.8	4.6	14.4	45.9	33.7	2.7
Sundergarh	65.1	62.8	74.2	12.8	15.1	21.9	22.1	22.1	3.9
Keonjhar	54.3	53.8	74.2	3.6	7.2	19.0	42.1	39.0	6.9
Mayurbhanj	53.9	64.1	84.5	36.3	16.1	9.0	9.8	19.8	6.6
Balasore	82.5	80.9	95.4	5.8	9.2	3.8	11.7	9.9	0.8
Cuttack	68.7	73.8	88.6	18.4	11.3	5.4	12.9	14.9	6.0
Dhenkanal	61.4	74.4	75.6	6.5	8.2	5.5	32.1	17.4	18.9
Baudh Khondmals	54.4	54.8	88.7	3.6	2.3	3.2	42.0	42.9	8.2
Bolangir	56.7	69.5	83.8	4.0	9.8	8.3	39.3	20.7	7.9
Kalahandi	58.7	64.1	75.0	13.1	7.7	16.8	28.2	28.2	8.2
Koraput	64.9	64.9	69.6	12.6	11.5	4.2	22.5	23.6	26.3
Ganjam	47.1	47.1	76.4	6.7	12.7	13.2	46.2	40.2	10.4
Puri	69.1	70.2	82.1	5.0	5.9	6.4	25.9	24.9	11.5
Total	59.8	64.5	79.9	10.5	9.3	9.5	29.7	26.2	10.6

Sources: Government of India, Directorate of Economics and Statistics, *Indian Agricultural Statistics*, reports for relevant years.

handi, the shares remained nearly constant. There was no association between rates of agricultural growth and changes in the relative importance of non-food crops. Also, there was no relationship between the percentage share of non-food crops in output and productivity levels in 1968-1971. The maximum share of output of non-food crops was 27 per cent recorded in Koraput, while the minimum recorded in Balasore, was 6 per cent. Non-food crops made much smaller gains in area over time, suggesting that the relative gain in the output of non-food crops was mainly due to increase in productivity.

Since there was extremely limited diversification of the crop pattern in Orissa, no attempt was made to undertake component analysis of agricultural growth along the lines done for Punjab.

4. Pattern of land use

The land utilization statistics of Orissa are not comparable over time, but the tentative figures on distribution of arable land by type of use are presented in table 46. These data cannot be interpreted very usefully because the very base, i.e. the area classified as arable land, has changed from time to time.

III. RELATIONSHIP BETWEEN POPULATION GROWTH AND AGRICULTURAL CHANGE

A. PUNJAB: PRE-INDEPENDENCE PERIOD

Two measures—static and dynamic—of population pressure[1/] at different points of time are presented in table 47. In 1911, net sown area available per male worker in agriculture was 6 acres at the state level. The interdistrict variations were significantly large; only 2.6 and 3.6 acres were available for cultivation to each male worker in Kangra and Hoshiarpur respectively, while Hissar and Ferozepur had almost 10 acres of net sown area for each male agricultural worker.

Analysis of data over the period 1911-1941 for the state as a whole reveals that net sown area per worker showed a decline which was only marginal until 1931, but, during 1931-1941, it declined significantly. In 1941, average cropped area per worker was only 4.7 acres, one fifth lower than it had been in 1911. This decrease was evidently caused by rapid population growth in the decade 1931-1941 which was not accompanied by a perceptible increase in the area under cultivation. During 1941-1951, however, the absolute decline in population, following partition of the country, resulted in a rise in net sown area per worker to 5.3 acres.

Table 47. Net area sown per male worker in agriculture in the districts of Pùnjab, 1911-1941

District	1911	1921	1931	1941
Hissar	9.9	10.9	10.0	8.1
Rohtak	7.7	6.8	6.0	5.4
Gurgaon	6.2	6.0	5.8	5.1
Karnal	5.3	5.1	6.1	4.3
Ambala	4.6	5.1	5.3	4.2
Kangra	2.6	2.8	2.3	2.1
Hoshiarpur	3.6	3.7	3.3	3.0
Jullundur	4.1	3.8	4.1	3.0
Ludhiana	6.8	5.8	5.7	4.4
Ferozepur	9.9	8.6	9.2	7.1
Amritsar	5.8	5.0	4.8	3.2
Gurdaspur	5.6	5.3	5.5	6.0
Total	6.0	5.7	5.8	4.7

Nearly all the districts shared the trend observed at the state level; i.e. marginal variations in the decades 1911-1921 and 1921-1931, significant decline in 1931-1941, and a reversal in the following decade. In Rohtak and Ferozepur, however, the decline was steadier and persisted in 1951. Gurdaspur, on the other hand, showed a virtually stationary land-labour ratio until 1931, a marginal increase between 1931 and 1941 and a marked decline in the following decade.

Table 48. Measures of population pressure in the districts of Punjab between 1911 and 1941

District	1911		1921		1931		1941	
	LPE	QEP	LPE	QEP	LPE	QEP	LPE	QEP
Hissar	20.8	3.4	12.6	2.2	11.0	1.9	13.5	2.9
Rohtak	7.3	1.2	6.5	1.1	5.4	0.9	5.2	1.1
Gurgaon	5.8	1.0	6.2	1.1	5.2	0.9	4.5	1.0
Karnal	12.9	2.1	12.4	2.2	13.2	2.3	12.1	2.6
Ambala	5.9	1.0	5.7	1.0	5.0	0.9	4.5	1.0
Kangra	5.9	1.0	6.5	1.2	5.8	1.0	5.5	1.2
Hoshiarpur	4.8	0.8	5.1	0.9	4.1	0.7	3.8	0.8
Jullundur	3.7	0.6	4.0	0.7	3.0	0.5	2.8	0.6
Ludhiana	6.0	1.0	5.5	1.0	4.3	0.7	4.2	0.9
Ferozepur	10.6	1.8	8.3	1.5	6.5	1.1	6.0	1.3
Amritsar	5.2	0.9	4.8	0.8	3.8	0.7	3.7	0.8
Gurdaspur	5.2	0.9	4.6	0.8	3.4	0.6	3.4	0.7
Total	8.1	1.4	7.2	1.3	6.3	1.1	6.0	1.3

Note: **LPE** refers to available land potential per prospective entrant to agricultural work force;

QEP refers to quotient of economic opportunity.

[1/] The concept and the measurement of population pressure are discussed at length in annex V.

As indicated in table 48, available land potential per prospective entrant (LPE) was 8.1 acres at the state level in 1911; it was higher than the net area sown per male worker in agriculture. However, the LPE showed a declining trend in each successive decade, so that, in 1941, only 6 acres were available per prospective entrant. During 1941-1951, it fell further to 4.7 acres. Nearly all the districts showed the same trend, although in varying degrees. The decline was most marked in Ferozepur where the LPE was 10.6 acres in 1911 and 5.3 acres in 1951, and also in Rohtak where it fell from 7.3 to 3.6 acres.[2] Karnal had an LPE of 12 acres until 1941, but showed a steep decline to about 8 acres in 1951.

One would ordinarily expect a negative association between net sown area per worker and the proportion of arable land that remains to be brought under cultivation. In Punjab, however, there were a few exceptions. In Ferozepur, high values of net sown area per male worker in agriculture in 1911 co-existed with even larger amounts of land potential. Although more and more unused land was brought under the plough in each successive decade, the net sown area per worker continued to decline slowly, evidently due to the progressive increase in the numbers dependent upon agriculture. Although Karnal and Kangra had large potentials in relation to the area already under crops, there was not much decrease in their LPEs until 1941, perhaps suggesting that the measures needed to reclaim more land were beyond the resources of the farmers. In Karnal, however, a sizable part of the unused land was brought under cultivation in 1941-1951, as is reflected in the rise in net sown area per worker. Kangra did not show any such progress in the decade 1941-1951. As would be expected, there were no significant trends in the LPEs in the districts where a large part of the arable land was under crops even in the initial years; the net sown area per worker, however, declined in about half of these districts between 1911 and 1951, evidently due to a rapid increase in the numbers dependent on agriculture.

The association between the initial land resource-population ratio and growth of rural population may now be examined. The bivariate distribution of districts by the extent of cropped acreage per worker at a point of time and the growth of population in the following decade is presented below in table 49. In two of the three decades examined, there was a measure of positive association between the initial area under cultivation per worker and the decennial growth of rural population. Thus, in the decades 1911-1921 and 1931-1941, four districts which had higher cropped acreage per worker also recorded higher growth of population, while four districts with below median values of net sown area per worker also had lower rates of population growth. In the 1921-1931 decade, however, the districts were equally distributed among the four quadrants.

Table 49. Bivariate analysis of relationship between net sown area per male worker in agriculture and percentage increase in rural population in districts of Punjab, 1911-1941

Net sown area per male worker	Percentage increase in rural population in the decade					
	1911-1921		1921-1931		1931-1941	
	High	Low	High	Low	High	Low
High	4	2	3	3	4	2
Low	2	4	3	3	2	4

The distribution of districts by LPE and percentage change in population also showed some measure of association in the decade 1911-1921 as indicated in table 50. Ferozepur and Ludhiana reported 13.3 per cent and 9.0 per cent increase in rural population, as against the state average of 3 per cent; the former also had a large available land potential per prospective entrant of 10.6 acres and the latter ranked number 5 in order of LPE. On the other hand, Gurgaon and Ambala, which showed an actual decline in rural population during 1911-1921, ranked numbers 8 and 6, respectively, in order of LPE. The bivariate distribution shows that four districts recorded above-median values of both LPE and population growth, while an equal number of districts had low values of both the variables. In the next decade, however, Ludhiana, Jullundur, Gurdaspur and Amritsar recorded relatively high rates of population growth even though the available land potential in these districts in 1921 was significantly lower than the state average. Curiously enough, five districts with high LPE reported below-median values of population growth. The third decade showed a scatter. In the last decade, 1941-1951, population growth was abnormally low. Population growth was above median in Hissar, Rohtak, Gurgaon, Karnal, Ambala and Kangra. They ranked, in order of LPE, 1, 5, 6, 2, 7 and 4 respectively. On the other hand, except for

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[2] The decline in LPE between 1911 and 1921 in Hissar appears due to some reporting error in the figure for 1911. While the area under current fallows was 0.2 million acres in 1909/10, 0.4 million in 1910/11, and 0.35 million in 1919/22, it was reported to be 1.15 million acres in 1911/12.

Ferozepur, all the districts which showed a significant decline in population during this decade also had lower than median levels of available land potential in the base year. This decade showed the expected relationship, five districts showing above-median values of LPE and population growth, and an equal number falling in the fourth quadrant with low values of both the variables, although no significance may be attached to this association since the population trends were dominated by the abnormal migratory flows between India and Pakistan after Partition.

Table 50. Bivariate analysis between available land potential per prospective entrant (LPE) and percentage increase in rural population in districts of Punjab, 1911-1951

		Percentage increase in rural population					
		1911-1921				1921-1931	
II (i)	LPE 1911	High	Low	II (ii)	LPE 1921	High	Low
	High	4	2		High	1	5
	Low	2	4		Low	5	1
		1931-1941				1941-1951	
II (iii)	LPE 1931	High	Low	II (iv)	LPE 1941	High	Low
	High	3	3		High	5	1
	Low	3	3		Low	1	5

It may be interesting to compare the net migration rates over the four decades with the initial degrees of population pressure. The relevant bivariate distributions are presented below. The range of net migration is significant only in the decades 1911-1921 and 1941-1951. The bivariate distributions for these decades showed the expected association, although in a limited measure, four out of six districts with high values of LPE showing relatively favourable net migration.

Since the absorptive capacity of agriculture depends on intensity of cropping and other factors affecting agricultural productivity as much as on land availability, increase in agricultural output was taken as a proxy for economic opportunities in agriculture and examined to determine if it bore any relationship to trends in population. Karnal and Ludhiana recorded the highest rates of increase in agricultural output in the decade 1911-1921; they also showed population increase at rates above the state average. However, Ferozepur ranked number one in order of population increase in spite of a significant decline in output at the rate of 3.6 per cent per annum. The bivariate distribution presented in table 52 below shows that four districts showed high rates of growth of both rural population and agriculture in the decade 1911-1921. In the next decade, there were only two districts with above-median values of agricultural growth recording relatively high rates of population increase. In the decade 1931-1941, however, five out of six districts with above-median values of growth rate in agriculture registered a relatively high rate of population growth.

Table 51. Bivariate analysis of the relationship between available land potential per prospective entrant (LPE) and net migration in the districts of Punjab, 1911-1951

		Net migration					
		1911-1921				1921-1931	
III (i)	LPE 1911	High	Low	III (ii)	LPE 1921	High	Low
	High	4	2		High	3	3
	Low	2	4		Low	3	3
		1931-1941				1941-1951	
III (iii)	LPE 1931	High	Low	III (iv)	LPE 1941	High	Low
	High	3	3		High	4	2
	Low	3	3		Low	2	4

The 30-year period from 1911 to 1941 was a period of virtual stagnation in agriculture but not in population growth. Population growth accelerated during this period in Punjab State, although, in some districts, the trend was not clear. However, five districts (Gurdaspur, Amritsar, Ferozepur, Ludhiana and Jullundur), which recorded relatively high rates of population increase (ranging from 34 to 48 per cent during 1911-1941 as against the range of 14 to 28 per cent in the remaining districts), were also the districts which ranked high in order of agricultural productivity in the base period. With the exception of Jullundur, these districts also indicated a relatively large net in-migration.

It may also be observed that Punjab had in general a fairly well-developed system of irrigation, but the five districts mentioned above had an above-average ratio of net area irrigated to net area sown. Thus, even though there was no major breakthrough

Table 52. Relationship between percentage increase in rural population and in agricultural output in the districts of Punjab, 1911-1941

Percentage increase in agricultural output	Percentage increase in rural population					
	1911-1921		1921-1931		1931-1941	
	High	Low	High	Low	High	Low
High	4	2	2	4	5	1
Low	2	4	4	2	1	5

in agriculture in terms of acreage expansion or technological progress during the period 1911-1941, there were significant interdistrict variations in levels of agricultural prosperity, and these appear to be positively related to population growth. People were mainly dependent on agriculture; when their numbers increased they tended to move and cluster in areas better supplied with agricultural facilities.

B. ORISSA: 1911-1951

For the four districts of Orissa, the net sown area and unexploited land potential per person of rural population are given in table 53. The latter roughly corresponds to the dynamic measure of population pressure known as LPL (available land potential per prospective entrant into the agricultural work force).

Of the four districts, Sambalpur had the highest land potential per person and also showed the highest rate of population growth in all the decades. More and more of the unused land was brought under cultivation so that the net sown area per person did not decline, although population experienced a positive and relatively high rate of growth after 1911. Puri ranked next in order of land potential as well as population growth. However, it recorded a fairly progressive decline in net sown area per person since there was no consistent trend in the utilization of land potential. Cuttack and Balasore showed lower land potential and also low rates of population growth over the period.

Our analysis of agricultural trends is restricted to the decades 1931-1941 and 1941-1951 because of non-availability of data for the preceding years. In 1931-1941, Sambalpur recorded the highest rate of growth of both population and agriculture; the latter largely through increases in the area under crops. Puri, however, showed an 8 per cent increase in population in spite of the heavy decline of 5 per cent per annum in output, and of 1.4 per cent in area during the decade 1931-1941. In the next decade, Puri registered the highest rate of growth of agricultural output as well as area under crops, 3.7 per cent and 4.0 per cent per annum respectively, but population increased by only 4.7 per cent over the decade. Sambalpur recorded an increase of 7.9 per cent in population with much lower rates of increase in output (0.2 per cent) and area (1.3 per cent). Cuttack and Balasore showed only marginal variations in both population and agricultural output. There is thus some relationship, though rather weak, between the growth of population and agriculture among the four districts of Orissa.

Table 53. Net sown area and unused arable land per person of rural population in four districts of Orissa, 1911-1941

District	Net sown area per person of rural population (acres)			
	1911	1921	1931	1941
Balasore	0.81	0.81	0.77	0.80
Cuttack	0.56	0.61	0.54	0.50
Puri	0.57	0.63	0.59	0.37
Sambalpur	1.00	0.94	0.86	1.00

District	Unused arable land per person of rural population (acres)			
	1911	1921	1931	1941
Balasore	0.10	0.20	0.21	0.29
Cuttack	0.22	0.17	0.24	0.23
Puri	0.17	0.32	0.40	0.43
Sambalpur	0.92	1.01	0.96	0.65

C. PUNJAB: 1951-1971

In studying the relationship between population trends and agricultural growth in Punjab during 1951-1971, due account will be taken of the regional variations in economic and social conditions which have come to the fore as a result of its bifurcation in 1966 into the two separate states of Punjab and Haryana. The districts which form part of Haryana had in general excellent records of agricultural growth in 1951-1961. However, the levels of productivity (per acre) attained by 1961 were still low by comparison with the average for composite Punjab and further, with the exception of Karnal, the districts registered comparatively low rates of output growth in the decade 1961-1971. On the other hand, the districts which constitute new Punjab had relatively prosperous agriculture in the earlier periods;

Table 54. Different measures of population pressure in the districts of Punjab, 1951-1971

District	1951-1961			1961-1971		
	Net sown area per male worker	Available land potential per prospective entrant into agricultural work force (LPE)	Index of economic opportunity (col. (3) divided by col. (2)	Net sown area per male worker	Available land potential per prospective entrant into agricultural work force (LPE)	Index of economic opportunity (col. (6) divided by col. (5)
1	2	3	4	5	6	7
Hissar	9.7	12.25	1.26	8.62	5.90	0.68
Rohtak	5.3	3.59	0.68	5.04	3.98	0.79
Gurgaon	5.8	3.22	0.56	5.37	3.56	0.66
Karnal	5.0	7.95	1.59	5.03	4.78	0.95
Ambala	5.8	3.78	0.65	4.46	3.91	0.88
Hoshiarpur	4.5	2.30	0.51	3.65	2.54	0.70
Jullunder	4.4	2.88	0.65	4.57	3.23	0.71
Ludhiana	5.2	3.34	0.64	5.36	4.18	0.78
Ferozepur	6.8	5.33	0.78	6.31	5.40	0.86
Amritsar	4.1	2.93	0.71	4.07	4.06	1.00
Gurdaspur	4.5	2.22	0.49	3.82	3.22	0.87
Bhatinda	7.0	4.43	0.63	7.08	4.99	0.70
Kapurthala	3.4	5.38	1.58	5.26	4.66	0.89
Mahendragarh	6.2	3.74	0.60	5.50	4.09	0.73
Patiala	3.9	8.45	2.17	5.47	3.96	0.72
Sangrur	4.5	3.98	0.88	5.53	3.79	0.68
Total	5.3	4.71	0.89	5.34	4.18	0.78

they showed, with a few exceptions, lower rates of growth in 1951-1961, but achieved a major breakthrough in agriculture in 1961-1971. The annual rates of output growth in bifurcated Punjab in the 1960s were high, but showed a significant range, varying from 6 to 12 per cent. This is interesting in so far as it provides a basis for comparison with interdistrict variations in population growth. Another difference is in the levels of urbanization of the two bifurcated states; in 1971, the proportion of urban population was 25 per cent in new Punjab and 18 per cent in Haryana. However, the districts of Haryana have the advantage of contiguity with Delhi, the capital of India, with market facilities and job opportunities.

The two measures of population pressure are given in table 54. The state average of net sown area per male worker in agriculture in both 1951 and 1961 was 5.3 acres. At the district level, it varied from 3.4 to 9.7 acres in 1951 and from 3.6 to 8.6 acres in 1961. The range in LPE in 1961 was somewhat narrower than in 1951. In 1961, it varied from 2.5 to 5.9 acres. In 1951, it varied from a low of 2.2 acres in Gurdaspur to a level as high as 12.2 acres in Hissar. The range in LPE is probably due to large-scale programmes of land reclamation in 1951-1961 which resulted in a significant reduction of unused land potential in Hissar, Patiala, Karnal and Kapurthala, which earlier had high LPEs.

It appears that, if all the unused arable land were reclaimed for cultivation between 1961 and 1971, and all the farm land falling vacant on account of the deaths among the farmers during the decade were added to it, the total acreage thus becoming available to each prospective male entrant into farming would still fall short of the average farm size in 1961. The value of the LPE divided by the state average of net sown area per male worker in agriculture gives ratios below unity in all the districts, thereby indicating "economic stress". This implies that, in the absence of a movement of the people to other states and/or off the farm, the economic prospects for fresh entrants into agriculture would be bleak unless there was a technological breakthrough and consequent significant intensification of farming.

1. Association between changes in demographic variables and agriculture

It may still be interesting, however, to examine whether there was any association across the dis-

Table 55. Bivariate analysis of relationship between net sown area per worker in the initial year and growth of rural population during the following decade in the districts of Punjab, 1951-1971

Net sown area per worker	Growth of rural population in the decade			
	1951-1961		1961-1971	
	Above median	Below median	Above median	Below median
Above median	6	2	6	2
Below median	2	6	2	6

Table 56. Bivariate analysis of relationship between available land potential per prospective entrant in the initial year and growth of rural population in the following decade in the districts of Punjab, 1951-1971

LPE	Growth of rural population in the decade			
	1951-1961		1961-1971	
	Above median	Below median	Above median	Below median
Above median	7	1	6	2
Below median	1	7	2	6

tricts between growth rates of rural population in 1951-1961 and 1961-1971 and (a) net sown area and (b) potentially available land per worker (LPE) in 1951 and 1961. The results of a simple cross-classification of districts by population growth and net sown area per male worker in agriculture in 1951-1971 are given in table 55.

Of the eight districts with above-median values of growth rates of rural population in both 1951-1961 and 1961-1971, six had also relatively higher values of net sown area per worker in 1961. In 1961-1971, the two exceptions were Kapurthala and Karnal, but the land-labour ratio in both these districts was only marginally below the median value. Again, six out of eight districts with relatively low rates of population growth also had below-median values of farm land in 1951 as well as 1961. Ambala and Ludhiana were agriculturally prosperous in terms of land and output per worker in 1951 and reported higher rates of population growth in 1951-1961 in all areas, but not so in rural areas presumably because the rapid expansion of the non-agricul[illegible]al sector attracted more people to urban areas. Patiala and Ferozepur were exceptions in 1961-1971; the former had a land-labour ratio nominally above the median value (0.1 acre), but the latter ranked high in order of farm size with 6.3 acres per worker as against a median value of about 5 acres. Thus, there seems to be a positive association between net sown area per worker in 1951 and 1961 and population growth rates in 1951-1971.

The bivariate distributions of districts by growth of rural population in 1951-1961 and in 1961-1971 and LPE are given in table 56. The scatter diagrams (figures 1 and 2) show the spread of districts. It is curious to note that the "stress" or "economic opportunity" measure shows very poor association with population growth. In 1951-1961, out of the eight districts with below-median quotients of economic opportunity, only four reported low rates of population growth in rural areas. The correlation of "economic opportunity" or "stress" quotient with rural rates was -0.34. On the other hand, seven out of eight districts with above-median values of LPE showed relatively higher rates of population growth in rural areas. The correlation value is 0.86. Kapurthala was the only district with high land potential but low population growth, presumably on account of the growing menace of waterlogging. The reason why Easterlin's measure does not reveal the expected association with population growth is that he assumes uniform size of farms (this was used as a proxy for consumption requirements in each state of the United States of America), while in Punjab there are large interdistrict variations in cropped area per worker. It appears that, in India, people move from one district to another in response to absolute land potential per entrant with little consideration for the relation that it would bear to the needs of persons already residing there (assuming the initial net sown area per worker to be a proxy for consumption requirements).

In 1961-1971, of the eight districts in the "high population growth" group, six had above-median values of LPE. The two exceptions were Sangrur

Fig. 1. Land potential per prospective entrant to agricultural work force, 1951 and growth of rural population, 1951-1961

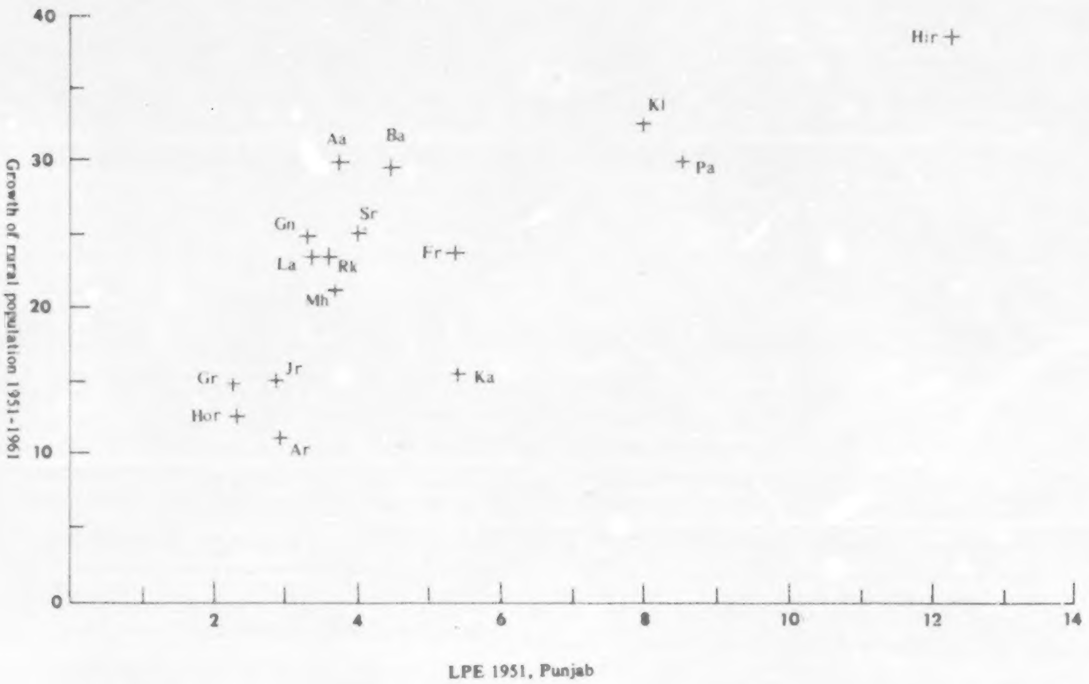
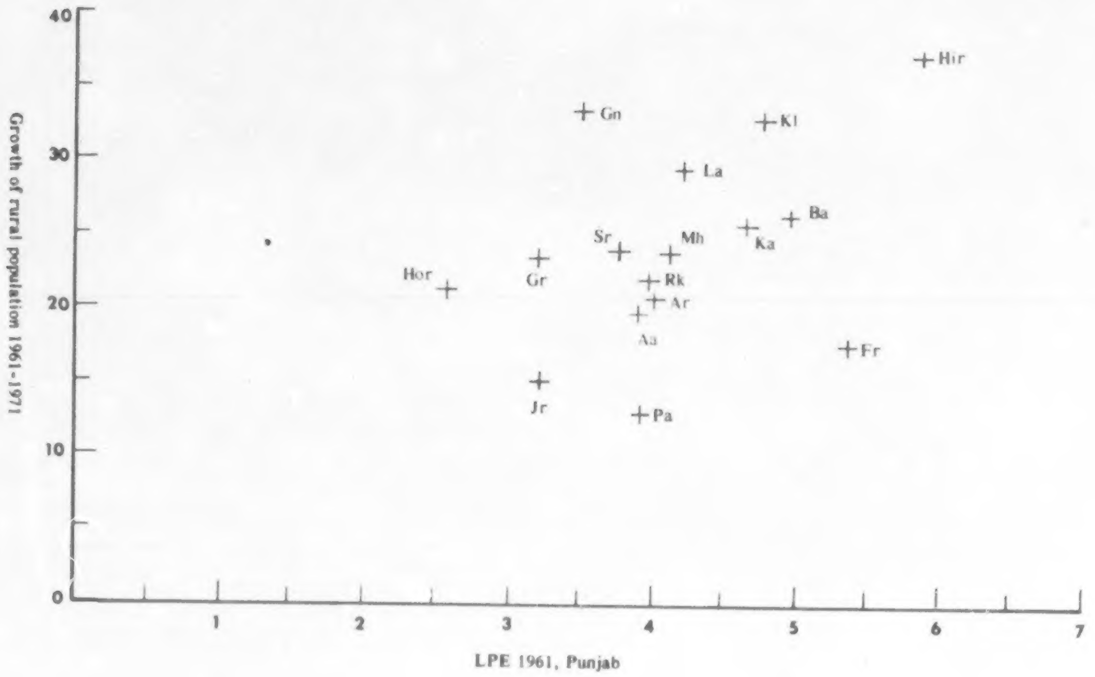


Fig. 2. Land potential per prospective entrant to agricultural work force, 1961 and growth of rural population, 1961-1971



Note. In figures 1-4, the following abbreviations are used for the names of the districts of Punjab:

Hir	Hissar	Fr	Ferozepur
Rk	Rohtak	Ar	Amritsar
Gn	Gurgaon	Gr	Gurdaspur
Kl	Karnal	Ba	Bhatinda
Aa	Ambala	Ka	Kapurthala
Hor	Hoshiarpur	Mh	Mahendragarh
Jr	Jallunder	Pa	Patiala
La	Ludhiana	Sr	Sangrur

and Gurgaon. Among the districts with low rates of population growth, Ferozepur and Mahendragarh also had above-median values of LPE. It appears that the decennial growth of population bears an even weaker relationship with LPE than with the ratio of net sown area per worker.

The districts with higher land potential obtained increases in their respective production largely through gains in net sown area. Six out of eight districts with above-median values of LPE also showed a relatively larger increase in acreage under crops. It is thus noted that the link between initial population-resource balance and growth of population is partly provided by growth of agriculture. One would expect association between expansion of acreage and population growth. During 1951-1961, seven out of eight districts with high rates or increase in cropped area also showed high rates of population growth in rural areas, the correlation value being 0.65. Again, of the eight high output growth districts, seven also reported higher rates of population increase. The simple correlation of growth of crop output with that of rural population was 0.87. The correlation value for growth of rural population improved to 0.91 when land potential per prospective entrant is also taken into consideration. There has been acceleration of agricultural growth in the period 1960-1963 to 1968-1971. However, the bivariate distribution of districts by growth of rural population and agricultural output does not suggest a strong association. But a close inspection of figures 3 and 4 showing growth rates of rural population against increase in output indicates that the points to the right of the 45° ray comprise the districts of reorganized Punjab, while those to the left belong to Haryana. Thus, the association between population growth and increase of output appears very close when it is considered separately for each bifurcated state. Among the districts of Punjab, Ludhiana, Kapurthala, Bhatinda, Gurdaspur and Sangrur showed relatively high rates of demographic as well as agricultural growth, while Patiala, Ferozepur and Hoshiarpur ranked low in order of both the variables. Amritsar, with an excellent record in agriculture (9 per cent increase in output per annum), showed a rate of population growth close to the state (reorganized Punjab) average. Jullundur, however, formed the major exception, showing a population growth of only 15 per cent, in spite of a fairly impressive increase (7.7 per cent per annum) in output. The districts which showed marked acceleration in agricultural growth in 1961-1971 compared with the preceding period recorded similar population growth.

Among the districts of Haryana, Hissar, Gurgaon and Karnal recorded a phenomenal growth of population in 1961-1971. Of these, Karnal also showed an excellent performance in agriculture. Gurgaon also recorded an annual increase of 5.7 per cent in agricultural output which is high by comparison with the average for Haryana. Hissar, however, appeared to be a major exception with the highest rate of population growth and an increase of only 3.8 per cent per annum in agricultural output. However, in 1951-1961, it has attained a phenomenal increase of 11 per cent per annum in agricultural output and 5.7 per cent per annum in cropped area, so that the *per capita* output in Hissar was nearly 50 per cent higher and a farm size almost double that of the state (composite Punjab) average. The high rate of population growth in this district in 1961-1971 thus appears to be supported by the level of agricultural prosperity already achieved by 1961, combined with moderate growth of agricultural output in the period 1960-1963, to 1968-1971.

It would be interesting to examine the relationship between potential availability of land and net migration, since the latter is supposed to be the major source of interdistrict variations in population growth. Net migration rates given in chapter I were obtained as the difference between growth rates and reported rates of natural increase.[3] A simple cross-classification of the net migration rates of the districts with the index of LPE yields the following results given in table 57.

It may be noted that, even though Punjab is less overcrowded than some other states and is agriculturally prosperous, it showed an excess of out-migrants over in-migrants at the state level. However, out of the eight districts with above-median values of land potential per prospective entrant, six not only showed above-median values of net migration but had net in-migration. All the eight districts

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[3] The vital statistics of Punjab, from which the latter were derived, are fairly reliable, but, since they lack absolute precision, the net migration rates can serve to indicate broadly the direction of movements but not precise magnitudes.

Fig. 3. Districts of Punjab according to growth of output and growth of rural population, 1951-1961

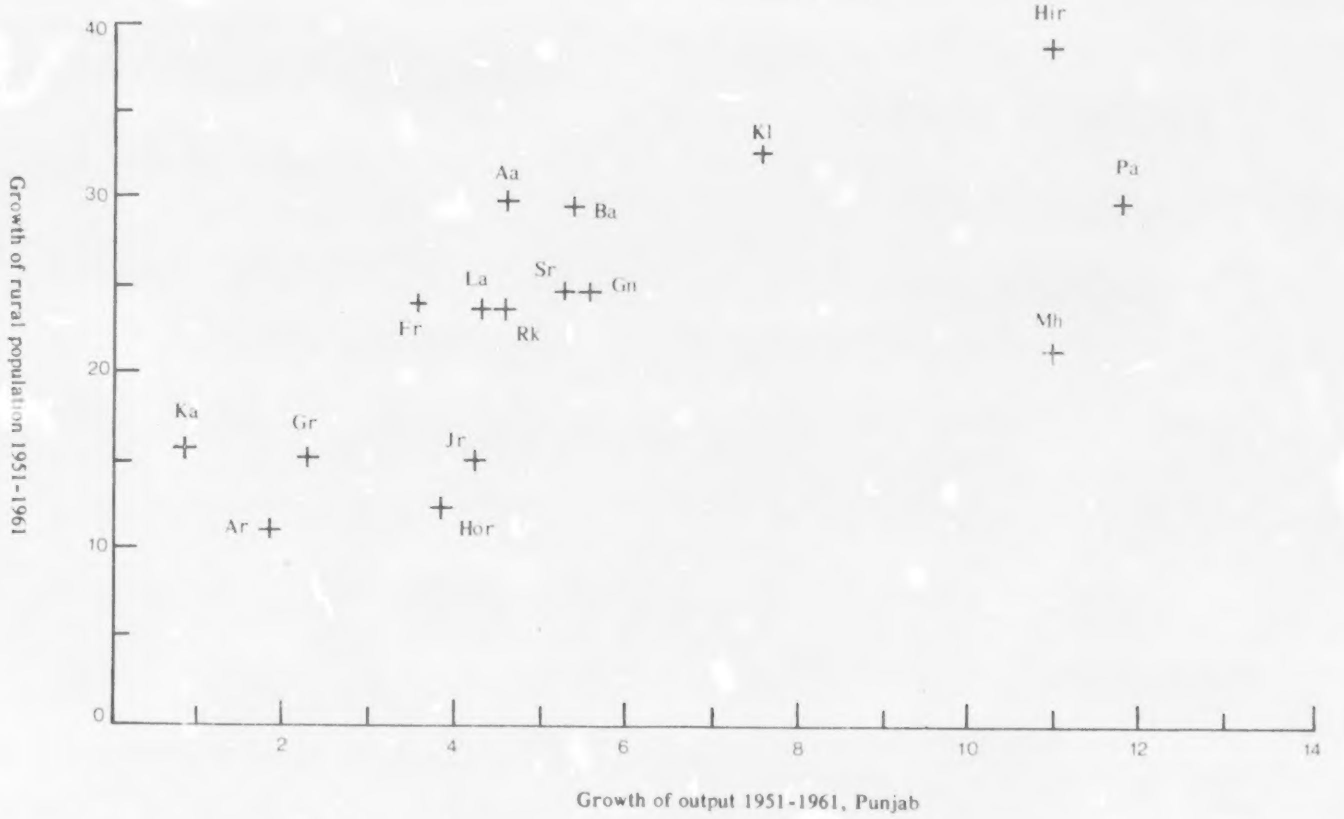

Fig. 4. Districts of Punjab according to growth of output and growth of rural population, 1961-1971

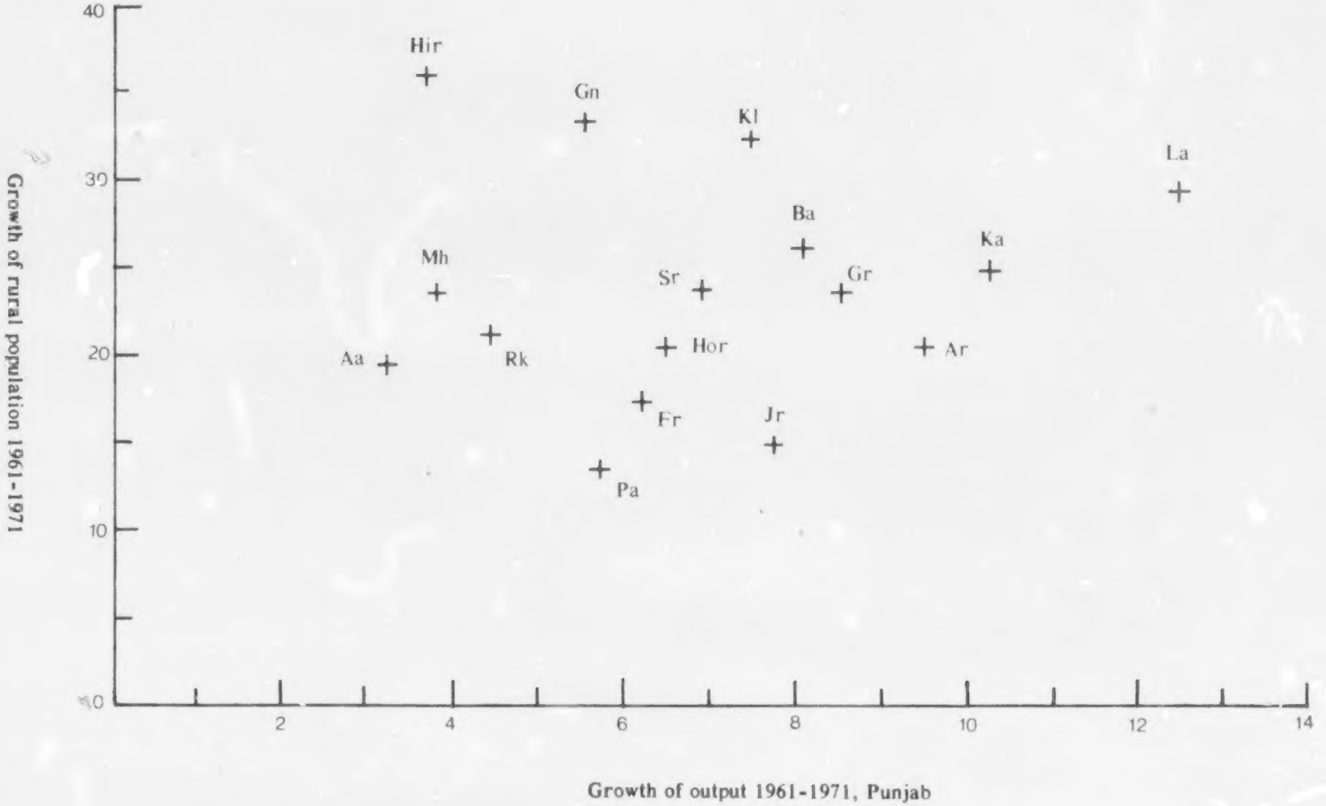

Table 57. Bivariate analysis of relationship between available land per prospective entrant in 1951 and rate of net migration in 1951-1961 in the districts of Punjab

LPE	Rate of net migration	
	Above median	Below median
Above Median	6	2
Below median	2	6

Note: Rate of net migration during 1961-1971 could not be obtained because of non-availability of relevant data.

with below-average values of land potential experienced net out-migration; six which had below-median values of land potential experienced net out-migration. The correlation value is 0.79, suggesting that potential availability of land is a factor helping to explain migration patterns.

2. Association between demographic variables and changes in agriculture

The discussion has so far pertained to the relationship between population changes and agricultural variables. In this section, the relationship between initial population resource balance and agricultural change is examined first, and then the combined effect of the two on the growth of population is investigated. The bivariate distribution of districts of Punjab by LPE and growth of agricultural output during 1951-1971 is given below in table 58. The association is positive but weak. It suggests that initial man-land balance, whether viewed from a static or a dynamic standpoint, is not a factor of great consequence in contributing to changes in agriculture in either 1951-1961 or 1961-1971.

Table 58. Bivariate analysis of relationship between land potential per prospective entrant (LPE) and growth of agricultural output in the districts of Punjab, 1951-1971

LPE	Growth of agricultural output			
	1951-1961		1961-1971	
	Above median	Below median	Above median	Below median
Above median	5	3	5	3
Below median	3	5	3	5

The two major components of growth of crop output are increase in acreage and rise in output per acre. The former can be further split into changes in net sown area and changes in multiple cropping. One would expect a region with smaller than average farm size to bring a large part of its arable land under the plough. But this is not always so. According to the 1951-1961 data, of the eight districts with below-median values of net sown area per worker, six had above-median percentage of unused arable land. Whereas, in Kapurthala and Patiala, 43 per cent and 37 per cent of arable land was lying unused. At the state level, the proportion of unused arable land was 25 per cent. In Kapurthala, productivity was high, so that output per worker in 1951 was Rs 688 per annum. This was substantially above the state average and suggests that higher marginal returns on investments in existing farms combined with higher costs of reclamation of waterlogged areas retarded further extension of cultivation. However, an increase of 38 per cent in net sown area in the 1960s, following the advent of planning, suggests the influence of external forces, such as more state aid in some form. In Patiala, output per worker was Rs 477 in 1951. Here, the net sown area increased by 72 per cent in the 1951-1961 decade. Among the districts with relatively larger net sown area per worker, only Hissar and Ferozepur had a below-median percentage of arable land lying unused (34 per cent and 22 per cent respectively) in 1951.

As expected, nearly all the districts with lower values of net sown area per worker also showed higher intensity of cropping, the correlation value between the two variables being -0.65. However, intensity of cropping did not always increase over time in districts with smaller farm size. The districts with higher agricultural density have ordinarily large output per acre; they also show increase in productivity over time, but the relation is statistically weak ('r'=0.41).

The cross-classification of districts by percentage increase in cropped area in 1961-1971 and net sown area per worker in the initial year revealed unexpectedly negative association (table 59).

Table 59. Bivariate analysis of relationship between net sown area per male worker and percentage increase in cropped area in the districts of Punjab, 1961-1971

Net sown area per male worker 1961	Percentage increase in cropped area 1961-1971	
	Above median	Below median
Above median	1	7
Below median	7	1

Assuming uniform levels of living aspirations and the propensity of people to do all that they can to meet them, one would ordinarily expect the over-crowded districts with low farm size to have already exploited their land potential in the initial period and, therefore, show comparatively lower rates of increase in gross sown area over time. It is observed, however, that Karnal, Ambala, Hoshiarpur, Amritsar, Gurdaspur and Kapurthala all had low farm size in 1961 and yet showed a comparatively larger increase in acreage. These districts had only 70 to 83 per cent of arable land under crops in 1961, confirming what was observed in the earlier period, namely that population pressure is not a sufficient condition for full exploitation of the land potential. Whether this is due to the weakness of the behavioural assumptions implied in the hypothesis or due to the specific nature of factors needed to develop land which lie beyond the limits of individuals' means remains unverified. It seems plausible, however, that, at later stages of development, land reclamation involves expensive measures that could be implemented only by the state through adequate allocation of funds during the plans.

Again, it is observed that several districts with high initial density, notably Karnal, Ambala, Jullundur, Amritsar, Kapurthala and in some measure Gurdaspur, were making intensive use of land reflected in high initial levels of productivity. With the exception of Ambala, however, all of them also recorded a significant rise in productivity over time. This is in sharp contrast to the trends in the 1950s when there was an inverse relationship between initial levels of productivity and its rise over time, and suggests the role of exogenous factors in development during the recent period.

D. ORISSA: 1951-1971

Alternative measures of population pressure in Orissa for 1951-1971 are presented in table 60. Agricultural density (4.7 acres of net sown area per male worker in agriculture for the state as a whole in 1951) was not significantly different from that in Punjab (5.3). Interestingly enough, Orissa's highest acreage per worker observed (9.8 acres in Koraput) equals Punjab's (9.7 for Hissar), and, similarly, the lowest value in Orissa (around 3 acres) corresponds closely to the situation in Punjab. By 1961, however, the net sown area per male worker in agriculture in Orissa had declined to 3.7 acres. This was true in almost all the districts, and varied from 2.7 to 5 acres per worker.

Table 60. Different measures of population pressure in the districts of Orissa, 1951-1971

District	1951-1961			1961-1971		
	Net sown Area per male worker	Available land poten - tial per prospective entrant into agri- cultural work force (LPE)	Index of eco- nomic op- portunity (col. (3) divided by col. (2)	Net sown area per male worker	Available land poten- tial per prospective entrant into agricultural work force (LPE)	Index of economic op- portunity (col. (6) divided by col. (5)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Sambalpur	5.4	15.4	2.9	4.7	6.6	1.4
Sundargarh	5.8	9.3	1.6	4.3	9.5	2.2
Keonjhar	4.7	9.6	2.0	3.7	8.2	2.2
Mayurbhanj	3.4	7.6	2.2	3.2	4.8	1.5
Balasore	4.5	5.1	1.1	2.9	1.9	0.7
Cuttack	3.2	4.9	1.5	2.5	2.0	0.8
Dhenkanal	5.1	7.[illegible]	1.5	4.1	4.8	1.2
Baudh Khondmals	7.2	17.4	2.4	3.7	10.6	2.9
Bolangir	4.6	9.9	2.2	4.0	2.8	0.7
Kalahandi	5.2	8.8	1.7	3.8	6.3	1.7
Koraput	9.8	12.9	1.3	5.0	9.9	2.0
Ganjam	3.4	9.5	2.8	2.8	5.1	1.8
Puri	3.4	5.1	1.5	2.7	2.6	1.0
Total	4.7	8.9	1.9	3.7	5.1	1.4

The potentially available land per prospective entrant (LPE) in Orissa in 1951 was nearly double that in Punjab. However, there were large inter-district variations in Orissa; the LPE was as high as 17 acres in Baudh Khondmals, whereas in Cuttack it was only 4.9 acres. In 1961, the range in LPE was much wider; the lowest value was 1.9 acres and the highest was over 11 acres. The values of LPE in 1961 were uniformly lower than those in 1951. However, the decline was, partly statistical and partly real. In Sambalpur, Mayurbhanj, Dhenkanal and Bolangir, the unused land potential had declined on account of land reclamation in 1951-1961. Available land potential per prospective entrant had also declined in most districts on account of an increase in the number of children 5-14 in 1961 compared with those in 1951, evidently due to a rising rate of population growth. In a few districts, notably Baudh Khondmals, the decline could partly be attributed to misclassification and over-reporting of land as cultivable wastes in 1951. Even then, in 1961 Baudh Khondmals recorded 10.6 acres available per prospective entrant into the agricultural work force in 1961-1971.

Table 61. **Bivariate analysis of relationship between available land potential per prospective entrant (LPE) and growth of rural population in the districts of Orissa, 1951-1971**

LPE	Growth of rural population			
	1951-1961		1961-1971	
	Above median	Below median	Above median	Below median
Above median	4	3	3	4
Below median	3	3	4	2

Table 62. **Bivariate analysis of relationship between increase in net sown area and growth of rural population in the districts of Orissa, 1951-1971**

Net sown area per male worker	Growth of rural population			
	1951-1961		1961-1971	
	Above median	Below median	Above median	Below median
Above median	3	4	4	3
Below median	4	2	3	3

Table 63. **Bivariate analysis of relationship between growth of output and growth of rural population in the districts of Orissa, 1951-1971**

Growth of output	Growth of rural population			
	1951-1961		1961-1971	
	Above median	Below median	Above median	Below median
Above median	3	4	3	4
Below median	4	2	4	2

The ratio between the available land potential in 1951 and workers likely to take up farming in 1951-1961 was higher than net sown area per worker as it obtained in 1951 at both the state level and the district level. In fact, this was so in every district of Orissa. A similar situation also prevailed to a certain extent in 1961-1971. Although the coastal districts of Balasore, Cuttack and Puri, as well as Bolangir, formed exceptions.

In Baudh Khondmals, Koraput, Sundergarh and Keonjhar, LPE ranged from 8 to 11 acres and was two to three times the average farm size per worker. Unlike Punjab, the prospects for extensive farming are much better in Orissa and the growing population can be sustained for some time by the reclamation of unused lands.

As indicated in table 61, unlike in Punjab, the LPE does not bear significant association with the growth of population in Orissa. Thus, out of seven districts with above-median LPE, only four showed above-median values of population growth in 1951-1961. In the subsequent decade, if anything, a negative association between potential land availability and population growth was observed, but the scatter was too wide to warrant any conclusion about the nature of relationship between the two variables.

Association between demographic variables and agricultural change

Where people are mobile, one would expect them to move to areas with rapid agricultural growth which would bring about a positive association between population growth and agricultural development. However, the bivariate distribution of increase in net sown area and growth of rural population, given in table 62, reveals the absence of any systematic relation between the two variables. In 1951-1961, of the seven districts with above-median values of increase in net sown area, four showed a relatively low rate of population growth. On the other hand, among the six districts with below-median values of expansion of acreage, four showed relatively high rates of population growth. The association in 1961-1971 between net sown area per male worker and the growth rate in rural pupuiation was also very weak and showed a wide scatter.

Growth of agricultural output gives increase in acreage adjusted for change in productivity. However, the data given in table 63 did not show any meaningful association between agricultural and population growth. Similar results were obtained when an attempt was made to examine the relationship between net migration rates and birth rates, the two major sources of interdistrict variations in population growth, on the one hand, and growth of crop output on the other.[4]

For the state as a whole, the growth of population showed some acceleration in 1961-1971 compared with the preceding decade, even though the rate of output growth declined from 4.9 to 4 per cent per annum in the two successive periods. At the same time, there were significant interdistrict variations in agricultural growth. The cross-classification of districts by growth rates in agriculture and in rural population gives the following results.

It is thus noted that, unlike in Punjab, demographic variables do not bear any systematic relationship with agricultural changes in Orissa. In fact, only three districts, Sundergarh, Keonjhar and Balasore, reported high rates of population growth compared with the state average. Part of this increase might have been due to net in-migration. However, these three districts had below-average rates of increase in crop output. On the other hand, districts like Kalahandi and Ganjam, which reported rates of agricultural growth as high as 10 and 9 per cent per annum respectively, had below-state average levels of population increase. Presumably, there was limited migration movement. In Orissa in general, there is very small migration, and the small volume that does exist does not show the expected relationship to changes in agriculture.

It was noted above that demographic variables bore no systematic relationship with agricultural change in Orissa, although one would expect high rates of natural increase in a backward region largely due to exogeneous factors to be accompanied by attempts to exploit the unused land potential and/or increase agricultural productivity to sustain the growing population. A simple cross-classification of districts by the available land potential and increase in net sown area in 1951-1961 and 1961-1971 gives the following results:

Table 64. Bivariate analysis of relationship between available land potential per prospective entrant and percentage increase in net sown area in the districts of Orissa, 1951-1971

LPE	Increase in net sown area			
	1951-1961		1961-1971	
	Above median	Below median	Above median	Below median
Above median	3	4	4	3
Below median	4	2	3	3

Increase in acreage formed a less important source of agricultural growth in Orissa than in Punjab. However, it is curious to note that Baudh Khondmals, Koraput, Keonjhar and Sundergarh all had significantly large land potential and yet recorded below-median increase in acreage. In fact, in 1961, Baudh Khondmals, with the highest LPE, showed only a 3 per cent increase in net sown area during 1961-1971. On the other hand, Mayurbhanj, with a relatively much lower LPE, recorded a 10 per cent gain in net sown area, whereas Sundergarh, Koraput, Keonjhar and Dhenkanal showed high values of LPE as well as relatively greater increases in net sown area. Interestingly, the maximum increase in net sown area recorded by any district was only 14 per cent. In the majority of districts, it ranged between 2 and 7 per cent, magnitudes too low to explain in any significant measure variations in population growth which lie in the range of 13 to 31 per cent. It appears, however, that individual effort to stabilize the area under cultivation, much less to increase it, is inadequate.

Since it is conceivable that land reclamation may be uneconomical compared with the productivity raising measures, it may be of some interest to examine the association between LPE and percentage rise in productivity as well as that in total agricultural output. Analysis of the relationship between potential land availability and agricultural growth, given in table 65 below, would also provide in some measure a clue to the absence of association between population pressure and demographic change. A relatively high rate of agricultural growth in districts which had large unused land potential in the initial year is not found. The bivariate distribution of LPE and growth of output showed very weak association between the two variables in both 1951-1961 and 1961-1971. In both decades, only three out of seven districts with above-median values of "land potential" also recorded relatively higher growth of output.

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[4] The net migration rates for the districts of Orissa were obtained by first estimating natural rate of increase. NIR was obtained by subtracting a constant death rate (estimated for the state as a whole) from the estimated birth rates. The difference between the over-all growth rates estimated for the intercensal period and the natural increase was taken to be net-migration rate. Since the death rates are likely to vary from one district to another, the net-migration rates thus derived would only broadly indicate the relative rates of movement in different districts.

Table 65. Bivariate analysis of relationship between available land potential per prospective entrant (LPE) and growth of agricultural output in the districts of Orissa, 1951-1971

LPE	Growth in output			
	1951-1961		1961-1971	
	Above median	Below median	Above median	Below median
Above median	3	4	3	4
Below median	4	2	4	2

Since there has been a relatively insignificant increase in net sown area, it is likely that large population movements follow increase in wage-paid employment. The two-way classification of districts given below brings out a measure of positive association.

Percentage increase in agricultural labourers 1961-1971	Growth rates of rural population 1961-1971	
	Above median	Below median
Above median	5	2
Below median	2	4

Figure 7 brings out some interesting features. There were two distinct clusters of districts. On the right side, Balasore, Cuttack, Puri and Ganjam are all coastal districts and Dhenkanal and Baudh Khondmals are just adjoining them. The other cluster on the left covers the remaining seven districts. Each group showed a significant measure of positive association between population growth and increase in agricultural labourers. No inference may be drawn about the direction of causality, however, since the increase in the demand for labour might induce in-migration, but, on the other hand, rapid population growth might have resulted in more people left without land and therefore working as agricultural labourers. Some clues may be obtained from the analysis of data on agricultural wages presented below in table 66.

There was an increase in agricultural wages in all the districts during 1961-1970. What is of particular significance in the present context is that the districts with high rates of increase in agricultural labourers in 1961-1971 showed both relatively high wage levels and larger increases in wage rates in the period 1960-1971. This appears to support the hypothesis that, with small increase in net sown area and limited prospects for the rapidly growing population to acquire land rights, people tended to move into areas which offered better opportunities for wage employment on the farm, and, further, that such movement did not retard the rise in agricultural wages.

Table 66. Average daily wage and percentage increase of male agricultural labourers in the districts of Orissa, 1961-1971

District	Average daily wage (Rs)		Increase in wage between 1961 and 1970	Percentage increase in male agricultural labourers, 1961-1971
	1961	1970		
Sambalpur	1.25	2.26	1.01	66.3
Sundergarh	1.25	2.06	0.81	79.8
Keonjhar	1.21	2.21	1.00	87.8
Mayurbhanj	1.00	1.60	0.60	63.9
Balasore	1.50	2.38	0.88	125.1
Cuttack	1.50	2.56	1.06	118.4
Dhenkanal	1.44	2.47	1.03	128.2
Baudh Khondmals	1.25	1.98	0.73	114.6
Bolangir	1.12	1.74	0.62	59.2
Kalahandi	1.04	1.90	0.86	55.8
Koraput	0.93	1.60	0.67	95.6
Ganjam	2.00	2.37	0.37	116.9
Puri	N.A.	2.69	-	101.8
Total	1.25	2.14	0.89	92.2

Sources: Census of India, 1961, vol. XII, *Orissa*, part I-A(ii), *General Report;*
Census of India, 1971, Series 16 — *Orissa* part II-A, *General Population Tables*

IV. POPULATION GROWTH, LABOUR SUPPLY AND AGRICULTURAL PRODUCTIVITY

A. PUNJAB

The analysis presented in the preceding chapters suggests positive association between growth of population and agriculture in Punjab during the decades 1951-1961 and 1961-1971. In order to gain insights into the process of interaction between the two variables, some additional variables are introduced. Although population growth is the main source of increase in labour supply, the precise relation between the two may be distorted by changes in concepts as well as in socio-economic factors affecting participation in economic activity.

In table 67, data on growth of rural population and male workers in agriculture are given. Female workers are not considered because the comparability in their case is seriously impaired by conceptual changes from one census to another.[1] The data show that male workers in agriculture increased in Punjab by about 15 per cent in 1951-1961 as against a growth rate of 24 per cent recorded by the rural population. In 1961-1971, however, the work force grew more rapidly than the population, the respective rates of increase being 27 per cent and 24 per cent.

Data for the districts show a good measure of correspondence between variations in the growth of population and work force. Hissar, Karnal, Patiala, Bhatinda and Sangrur showed relatively high rates of population growth in 1951-1961, ranging from 27 to 48 per cent; the gains in labour in these districts were also high, varying from 18 to 50 per cent. At the other end, Hoshiarpur, Jullundur, Ludhiana, Amritsar, Gurdaspur and Kapurthala registered low rates of population growth, varying from 10 to 17 per cent. Except for Hoshiarpur, they also recorded low increases in the work force, which were even below 10 per cent. Gurdaspur and Kapurthala actually indicated absolute declines of 17 per cent and 9 per cent respectively.

The supply of agricultural labour relative to the

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[1] Further, in Punjab a small proportion of women work in the agriculture sector or any other sector according to the 1961 Census, 14.2 per cent of all women worked.

Table 67. Percentage increase in rural population and male workers in agriculture in the districts of Punjab, 1951-1971

District	Percentage increase in rural population		Percentage increase in male workers in agriculture	
	1951-1961	1961-1971	1951-1961	1961-1971
Punjab	24.0	24.2	15.2	27.3
Hissar	48.0	36.8	50.0	20.2
Rohtak	26.3	21.7	10.2	14.1
Gurgaon	25.1	33.6	16.2	13.9
Karnal	41.3	32.7	39.8	27.4
Ambala	21.8	19.5	27.0	26.8
Hoshiarpur	9.9	21.0	24.5	24.0
Jullundur	12.6	15.0	10.1	34.7
Ludhiana	17.7	29.4	9.2	74.8
Ferozepur	23.0	17.6	15.8	30.7
Amritsar	10.4	20.6	0.8	41.5
Gurdaspur	14.6	23.2	17.5	34.4
Bhatinda	28.9	26.4	28.0	39.6
Kapurthala	14.7	25.3	-8.2	36.9
Mahendragarh	22.6	23.4	0.7	9.1
Patiala	39.5	13.2	18.0	26.7
Sangrur	27.3	23.7	12.0	24.1

Sources: (1) Census of India, 1961, vol. XIII *Punjab*, part II-A, *General Population Tables*, and part II-B (i), *General Economic Tables*;
(2) Census of India, 1971, Series 17 - *Punjab*, part II-A, *General Population Tables*;
(3) Census of India, 1971, Series 6-*Haryana*, part II-A, *General Population Tables*.

growth of rural population in 1961-1971 presents a picture of surprising contrast between Haryana and Punjab. The increase in labour force lagged behind that of rural population in all the districts of Haryana except Ambala. In reorganized Punjab, all the districts showed a relatively faster increase in agricultural labour. Further, the growth rates of the agricultural work force were 50 to 100 per cent higher than those of the rural population in the districts belonging to the "high" output growth group. It may suggest that the accelerated growth of agriculture has encouraged a reverse movement of workers from industry and services into agriculture.

A simple cross-classification of districts by growth of output and growth of work force yields the following results given in table 68 and figures 5 and 6.

Table 68. Bivariate analysis of relationship between growth rate in agriculture and percentage increase in male workers in agriculture in districts of Punjab, 1951-1971

Growth rate in agriculture	Increase in male workers in agriculture			
	1951-1961		1961-1971	
	Above median	Below median	Above median	Below median
Above median	7	1	7	1
Below median	1	7	1	7

A strong relationship between growh of output and workers in agriculture is suggested in this table. Of the eight districts in the "high" output growth group, seven also showed a higher increase in work force. The two decades showed the same distribution. The only exception in 1951-1961 was Mahendragarh, but it had an extremely low base of productivity level so that even a large increase in output failed to attract additional workers into agriculture. The exception in 1961-1971 was Sangrur, but its output growth was only marginally above the median value.

Data on extension of net sown area and growth of agricultural work force on the other hand, suggest a positive but weak association. In 1951-1961, of the eight districts with a relatively large expansion of acreage, five also indicated a rapid increase in work force. An increase of 38 per cent in acreage in Kapurthala was accompanied by an absolute fall in the number of agricultural workers. At the same time, Ambala and Hoshiarpur recorded significant increases in work force in spite of an absolute decline in net sown area. In 1961-1971, the magnitude of area increase was limited, while the increase in the agricultural work force was significant, especially in the districts of reorganized Punjab. The cross-classification of districts by increase in net sown area and that in agricultural work force in 1961-1971 again showed only five districts out of eight, with relatively larger area gains, recording higher rates of increase in work force. Large extensions of net sown area, particularly impressive in some districts in 1951-1961, were the result of land reclamation programmes and irrigation works organized by the state; they ordinarily attracted large additions to the work force, but there were exceptions suggesting that area increase is not a sufficient condition for labour in-migration. Also, it is not a necessary condition since workers moved into agriculture in some cases in large numbers in districts with low increase or even absolute decline in net cultivated area.

An analysis of the relationship between growth of agricultural work force and increase in the intensity of land and water utilization suggests some interesting facts. In Hissar, Karnal, Ambala and Patiala, large increases in work force contributed to a significant rise in the intensity of cropping in 1951-1961. However, significant increases in cropping intensity were registered without a similar trend in the labour force in Mahendragarh and Gurdaspur. Similarly, in 1961-1971, Karnal, Ambala, Jullundur, Ludhiana, Ferozepur and Bhatinda combined a rapid growth of agricultural labour with an impressive rise in cropping intensity. But Bhatinda showed only a moderate rise in the intensity of land use and Kapurthala showed a nominal decline in spite of a rapid increase in work force. The association between growth of work force and intensity of land utilization was thus positive but not significant.

Output per hectare provides a convenient summary measure of the intensity of land utiliza-

Table 69. Bivariate analysis of relationship between growth rate in output per hectare and percentage increase in male agricultural work force in districts of Punjab, 1951-1971

Growth rate in output per hectare	Increase in male workers in agriculture			
	1951-1961		1961-1971	
	Above median	Below median	Above median	Below median
Above median	6	2	6	2
Below median	2	6	2	6

Fig. 5. Districts of Punjab according to increase in male workers in agriculture and in output, 1951-1961.

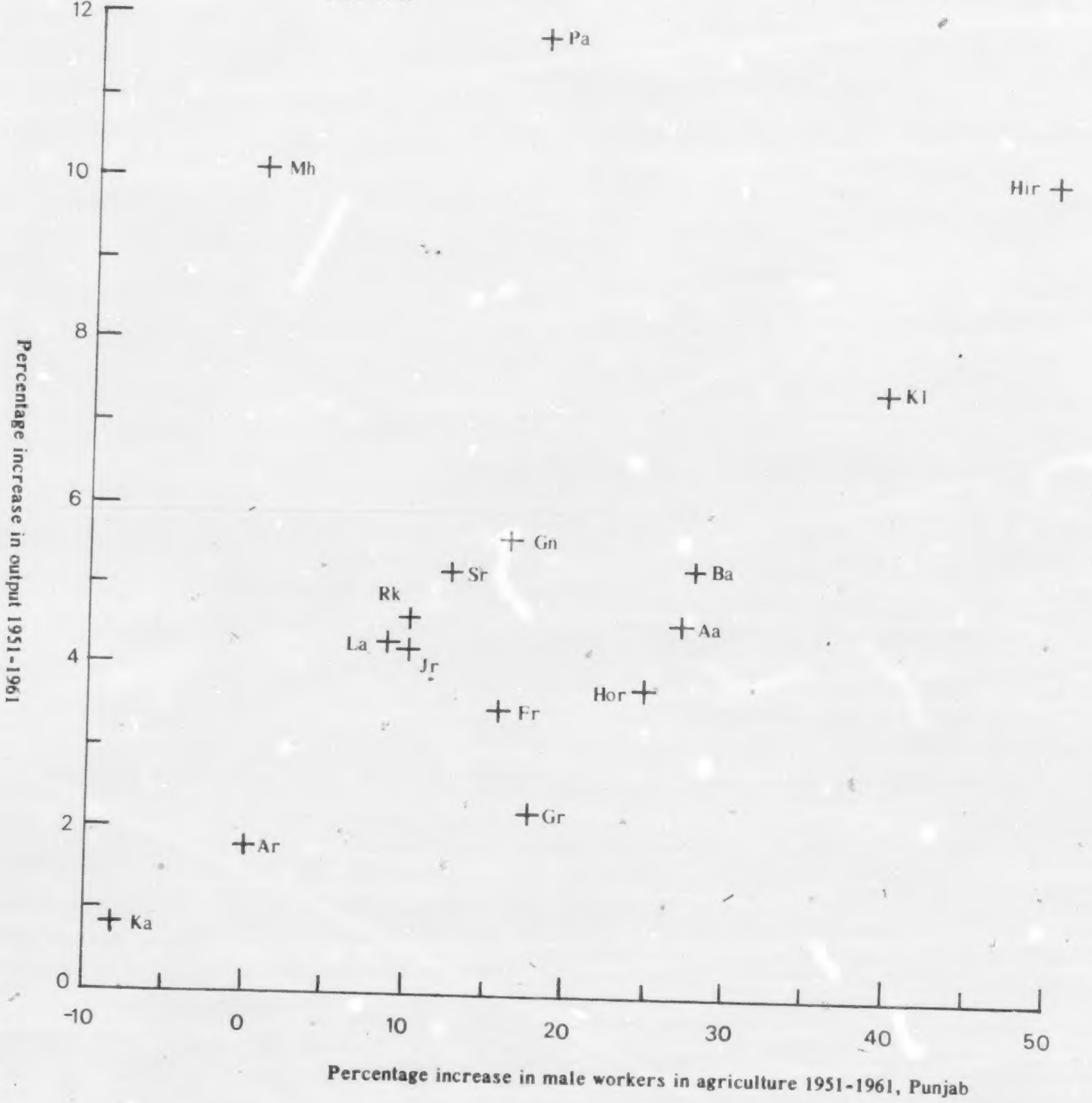
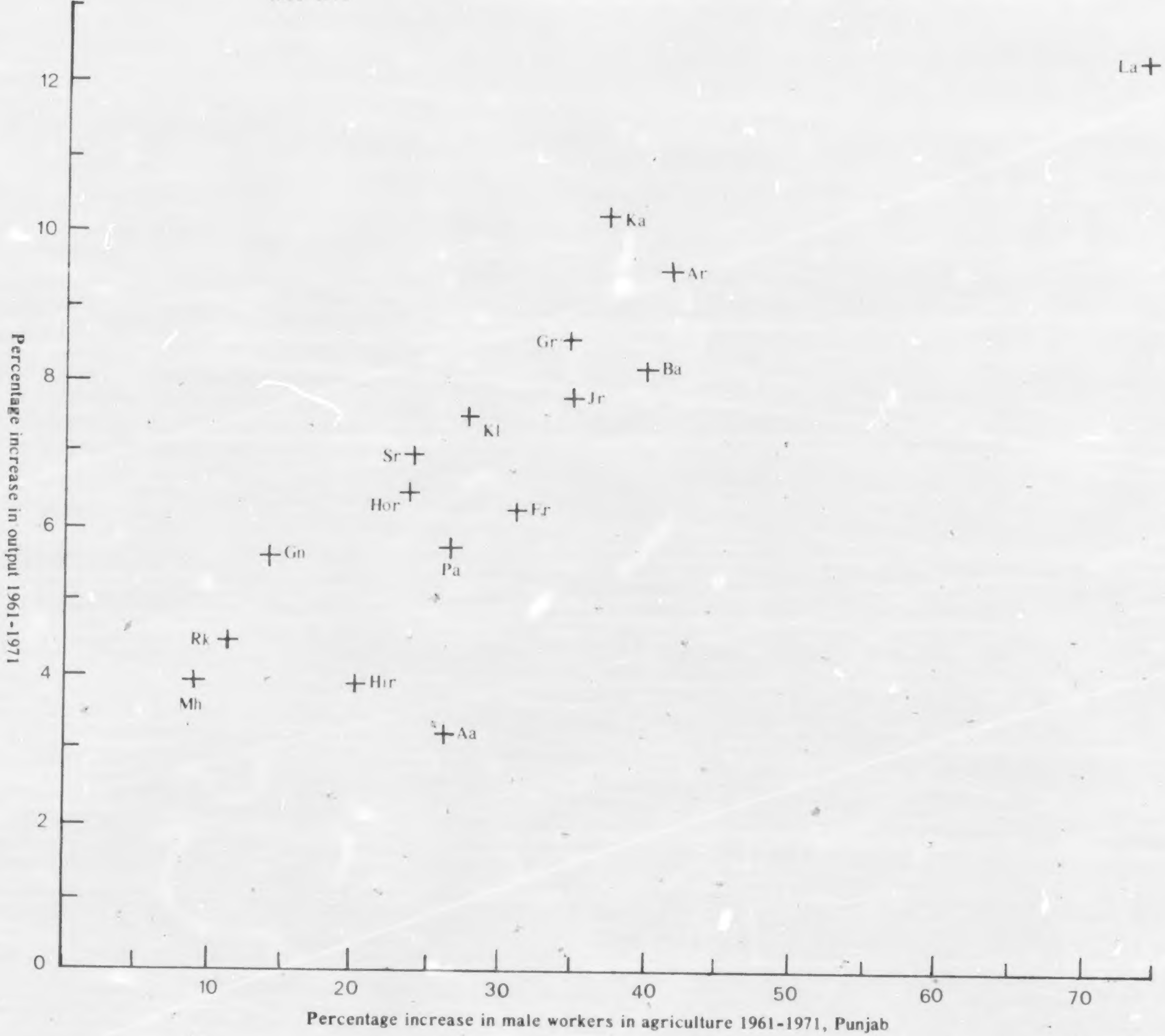


Fig. 6. Districts of Punjab according to increase in male workers in agriculture and in output, 1961-1971



tion. The cross-classification of districts by growth of work force and changes in productivity per hectare is presented below to bring out the role of labour in agricultural development through intensive utilization of the limited land resources.

Hissar, Gurgaon, Ambala, Hoshiarpur, Bhatinda and Patiala showed very high rates of increase in agricultural output in the decade 1951-1961 compared with 1961-1971. The increase was largely due to exogenous factors, such as the state initiative and resources which encouraged in-migration of people and labour, although there were exceptions to this general trend. At the same time, large increases in the agricultural labour force were observed in some districts without marked gains in cultivated area. Such divergent trends in land and labour altered the ratios of net sown area to male workers in agriculture. Net sown area per worker declined in half the number of districts between 1951 and 1961; the percentage decrease ranged from 6 to 23: Kapurthala, Patiala and Sangrur, however, recorded large gains of 56, 41 and 22 per cent respectively. In the remaining five districts, the gains were nominal, varying from 1 to 6 per cent. On the other hand, the decline in gross sown area per worker between 1951 and 1961 was confined to three districts. The maximum gains recorded were 74 per cent in Patiala and 63 per cent in Kapurthala; in other districts they ranged from 7 to 37 per cent. The differences in the trends of net sown area and gross sown area in relation to male workers in agriculture perhaps suggest the role of individual effort in more intensive land utilization. Similar trends were observed in 1961-1971. During this decade, net sown area per worker declined in all the districts, the losses ranging from 4 to 27 per cent. Gross sown area per worker also declined in all the districts but one, although the percentage decreases were of lower magnitudes.

Close association was observed in 1951-1961 between agricultural work force and productivity. Karnal and Sangrur, with large additions to the labour force in the decade, also recorded moderate gains in productivity which, although below the median value, exceeded the state average of productivity increase. The districts with low rates of labour force growth also recorded slow increases in productivity. Mahendragarh was the major exception, with an impressive increase in productivity and a low rate of labour force growth. This could perhaps be explained by improved utilization of the existing labour force which had an extremely low productivity level in the base period. In 1961-1971, the two exceptions where above-average increase in labour force was not accompanied by relatively high growth of productivity were Jullundur and Ferozepur. However, both districts showed substantial absolute gains in output per acre at the rate of 4.5 and 4.8 per cent per annum respectively, combined with high base level productivity. Among the districts with a relatively low growth of labour force, Gurgaon and Sangrur showed somewhat higher gains in productivity; in the former it may be explained in terms of the low base, while, in the latter, the increase in agricultural labour itself was substantially high (24 per cent) although a little below the median value.

The analysis has so far been confined to cross-temporal comparisons between growth of work force and increase in agricultural output as well as in some of the related factors. The results obtained suggest that the role of labour in the development of agriculture and raising the intensity of land use is positive. Evidently, other factors must be taken into consideration to provide a complete explanation of the variability in agricultural growth. Attention must also be drawn to important limitations of the data, such as an element of non-comparability in labour force over time introduced by conceptual changes. An attempt is made to minimize the limitations of data by restricting the analysis to male workers. The results, therefore, may be taken as indicating broad orders of magnitudes. For more precise analysis, however, cross-sectional comparisons are made. These include, in addition to labour force, a few other variables related to agricultural development.

The technique adopted is multivariate regression analysis. An attempt is made to explain variations in total agricultural production, output per acre of cropped area and output per male worker in agriculture (dependent variables). The explanatory variables are gross sown area, gross irrigated area, male work force in agriculture, fertilizers and implements (which comprise ploughs, tractors, pump-sets, oil engines and sugarcane crushers) Fertilizers are measured in terms of nutrient units, while the value of implements is obtained by aggregating the different items, giving each of them their respective price weights.

The simple correlation values given in table 70 indicate that variations in total output bear significant relationship with all the explanatory variables except fertilizers in 1961. There is also a measure of auto-correlation between some of the explanatory variables. It is notably high between land and labour, the correlation between the two being 0.874 in 1951, 0.902 in 1961 and 0.918 in 1971. We get over the difficulty introduced by this in the second and the third series of regression equations where the dependent variables are output per acre and output per worker so that land gets eliminated from the independent variables in the second set and labour from the third set. There is also positive correlation between irrigation and implements, being as high as 0.847 in 1961, and between irrigation and fertilizer in 1971 (0.800) which must be kept in view in interpreting the results of the regression equations.

Table 71 presents the results of the log-linear regression equations fitted by the least squares to the data of four districts of Punjab at three different points of time; 1951, 1961 and 1971. It is divided into three parts. Part (a) explains variations in total output and parts (b) and (c) give the results for output per acre and output per male worker respectively. The regression coefficients in 71 (a) measure the elasticity of output with respect to independent variables, such as gross area sown, gross irrigated area, and fertilizers. The *t*-values given in parentheses indicate the statistical significance of the regression coefficients. The results for each year relate to a set of two equations. Equation (1) includes land, irrigation and agricultural labour among the explanatory variables. Considering the significant auto-correlation between land and labour, the former is dropped in equation (2) and two additional variables, fertilizers and implements, are included.[2]

The results obtained by fitting equation (1) show that land, irrigation and labour explained between them 82 per cent of the variance in output in 1951, 92 per cent in 1961 and 96 per cent in 1971. Of the three independent variables, labour

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[2] Fertilizer, however, was not in use in 1951. It formed one of the inputs, though a nominal one, in 1961; it was used in a substantial measure only in 1971. Similarly, the implements used in 1951 were of the traditional variety. Modern implements, mainly tractors, pump-sets and oil engines, came into use in the 1960s and induced substantial investments by 1971.

Table 70. Correlation matrices for the regression equations, Punjab

Years and variables	Dependent variable	Independent variables				
	Total output	Gross sown area	Gross irrigated area	Agricultural workers (males)	Fertilizers	Implements
	Y	X_1	X_2	X_3	X_4	X_5
1951						
Y	1.000	0.712	0.844	0.792	–	0.752
X_1		1.000	0.476	0.874	–	0.713
X_2			1.000	0.576	–	0.397
X_3				1.000	–	0.293
X_4					–	–
X_5						1.000
1961						
Y	1.000	0.877	0.760	0.912	0.374	0.832
X_1		1.000	0.525	0.902	0.188	0.548
X_2			1.000	0.540	0,448	0.847
X_3				1.000	0.099	0.596
X_4					1.000	0.714
X_5						1.000
1971						
Y	1.000	0.811	0.946	0.916	0.780	0.790
X_1		1.000	0.662	0.918	0.305	0.665
X_2			1.000	0.788	0.880	0.623
X_3				1.000	0.550	0.742
X_4					1.000	0.595
X_5						1.000

(Cont'd)

Table 70 (Cont'd)

Years and variables	Dependent variable	Independent variables			
	Output per acre Y	% Area under irrigation X_1	Male workers per acre X_2	Fertilizer per acre X_3	Implements per acre X_4
1951					
Y	1.000	0.790	0.615	–	0.782
X_1		1.000	0.335	–	0.587
X_2			1.000	–	0.603
X_3				–	–
X_4					1.000
1961					
Y	1.000	0.719	0.619	0.076	0.887
X_1		1.000	0.183	0.529	0.765
X_2			1.000	0.735	0.414
X_3				1.000	0.788
X_4					1.000
1971					
Y	1.000	0.902	0.728	0.906	0.599
X_1		1.000	0.496	0.786	0.311
X_2			1.000	0.843	0,510
X_3				1.000	0.574
X_4					1.000

(Cont'd)

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Table 70 (Cont'd)

Years and variables	Dependent variable	Independent variables			
	Output per male worker in agriculture Y	Gross sown area per worker (male) X_1	Gross irrigated area per worker (male) X_2	Fertilizer per worker (male) X_3	Implements per worker (male) X_4
1951					
Y	1.000	0.127	0.783	–	0.565
X_1		1.000	0.026	–	0.501
X_2			1.000	–	
X_3				–	0.421
X_4					1.000
1961					
Y	1.000	0.353	0.773	-0.239	0.829
X_1		1.000	-0.125	-0.630	0.009
X_2			1.000	-0.060	0.765
X_3				1.000	-0.217
X_4					1.000
1971					
Y	1.000	-0.178	0.910	0.698	0.392
X_1		1.000	-0.813	-0.745	-0.083
X_2			1.000	0.652	0.092
X_3				1.000	0.269
X_4					1.000

Table 71 (a). Parameter estimates for output in districts of Punjab

Dependent variable: Total output	Independent variables					R^2	Degrees of freedom
	Gross sown area	Gross irrigated area	Male workers in agriculture	Fertilizers	Implements		
1951							
Eq. (1)	0.1451 (0.7039)	0.3355 (4.5595)	0.4645 (1.3795)	–	—	0.8130	12
Eq. (2)		0.2641 (3.0546)	0.6080 (3.3428)	–	0.2139 (0.3224)	0.8295	12
1961							
Eq. (1)	0.2125 (1.4087)	0.2083 (4.5953)	0.6376 (3.2817)			0.9242	12
Eq. (2)		0.0515 (0.7698)	0.7445 (6.8676)	-0.0190 (-0.4598)	0.3680 (2.1029)	0.9522	11
1971							
Eq. (1)	0.0508 (0.3803)	0.4011 (7.9382)	0.4918 (2.6100)			0.9630	12
Eq. (2)		0.4095 (8.9221)	0.3737 (4.8785)	-0.0284 (-0.8138)	0.1852 (4.1905)	0.9844	11
			Marginal products				
1951							
Eq. (1)	18	106	285				
Eq. (2)		84	373		4		
1961							
Eq. (1)	33	85	555				
Eq. (2)		21	735	-7424	3.4		
1971							
Eq. (1)	12	153	891				
Eq. (2)		156	677	-256	0.6		

Table 71 (b). Parameter estimates for output per acre in districts of Punjab

Dependent variable: Output per acre		Independent variables				R^2	Degrees of freedom
		Gross irrigated area	Male workers in agriculture	Fertilizers	Implements		
1951							
	Eq. (1)	0.3301 (4.7595)	0.5520 (2.8610)			0.7119	13
	Eq. (2)	0.2661 (3.4305)	0.2953 (1.2025)		0.2311 (1.5726)	0.7925	12
1961							
	Eq. (1)	0.2103 (4.7406)	0.5512 (3.8153)			0.7128	13
	Eq. (2)	0.0464 (0.9612)	0.4395 (2.9234)	0.0772 (1.1680)	0.1816 (2.1036)	0.8716	11
1971							
	Eq. (1)	0.3822 (7.8333)	0.5929 (4.0661)			0.8989	13
	Eq. (2)	0.3744 (6.3655)	0.4123 (2.1228)	-0.0040 (-0.0556)	0.1772 (3.5137)	0.9487	11
				Marginal products			
1951							
	Eq. (1)	104	338				
	Eq. (2)	84	181		4.6		
1961							
	Eq. (1)	107	461				
	Eq. (2)	18	282	25132	1.7		
1971							
	Eq. (1)	146	701				
	Eq. (2)	143	487	-36	0.6		
			Geometric means of the variables				
1951		0.3979	0.205		6.3		
1961		0.3900	0.180	0.000476	17		
1971		0.5999	0.190	2.5	63.0		

Table 71 (c). Parameter estimates for output per worker in districts of Punjab

	Dependent variable: Output per male worker in agriculture	Independent variables				R^2	Degrees of freedom
		Gross sown area	Gross irrigated area	Fertilizers	Implements		
1951							
	Eq.(1)	0.1178 (0.6479)	0.3301 (4.7595)			0.5436	13
	Eq.(2)	0.2075 (1.1390)	0.2661 (3.4305)		0.2311 (1.5726)	0.5871	12
1961							
	Eq.(1)	0.2385 (1.6662)	0.2103 (4.7406)			0.5918	13
	Eq.(2)	0.4378 (3.0918)	0.0394 (0.7449)	0.0363 (1.4986)	0.3270 (4.0135)	0.7977	11
1971							
	Eq.(1)	0.0248 (0.1927)	0.3822 (7.0333)			0.7893	13
	Eq.(2)	0.0401 (0.2299)	0.3744 (6.3655)	-0.0040 (-0.0556)	0.1772 (3.5137)	0.8931	11
		Marginal products					
1951							
	Eq.(1)	15	104				
	Eq.(2)	26	84		4.6		
1961							
	Eq.(1)	37	86				
	Eq.(2)	68	16	1447	3.0		
1971							
	Eq.(1)	6	146				
	Eq.(2)	9	143	-36	0.6		
		Geometric means of variables					
1951	(613)	4.9	1.9		32		
1961	(871)	5.6	2.1	0.0046	94		
1971	(1182)	5.2	3.1	0.1320	326		

was by far the most significant input, bearing coefficient values of 0.46, 0.63 and 0.49 at three successive points of time. Irrigation came next in importance with coefficients of 0.33, 0.21 and 0.40 in 1951, 1961 and 1971 respectively. The elasticity coefficients of land were low and statistically insignificant, but they cannot be interpreted meaningfully in view of the high orders of correlation between land and labour. By the same token, the interpretation of the coefficients of labour was not easy, although the high *t*-values in 1961 and 1971 gave a measure of confidence in our results.

The results from equation (2), in which land was excluded and the additional variables of fertilizers and implements were introduced, indicated that the explained variance in output rose to 83 per cent in 1951 and 95.2 and 98.4 per cent in 1961 and 1971 respectively. Regression coefficients of labour were statistically significant in each year and assumed high values of 0.61 and 0.74 in 1951 and 1961 respectively. In 1971, however, it dropped to 0.37 and was slightly overshadowed by irrigation. The coefficients of irrigation were statistically significant in 1951 and 1971 but not in 1961. It assumed the value of 0.40, in 1971, which perhaps suggests the importance of its contribution in the new seed-water-fertilizer package of inputs. Fertilizers formed a substantial input in 1971 (though not in 1961); and showed a positive correlation of 0.76 with output. The regression coefficient, however, was surprisingly negative and statistically insignificant. In view of the high correlation between fertilizer and irrigation ($r = 0.8$), it may be inferred that the contribution of fertilizers to output is captured by irrigation and that this partly explains the high value of the regression coefficient of irrigation. The elasticity coefficients of output with respect to implements were statistically significant in 1961 and 1971, the respective values being 0.37 and 0.19. The relatively large value in 1961 was perhaps due to correlation between implements and irrigation; the former seemed to span a part of the latter's contribution to output. This seems to be confirmed by the simple correlation between output and irrigation which was positive (0.76) and significant.

The results presented in table 71 (b) relate to variations in output per acre. Equation (1) includes irrigation and labour as explanatory variables. Fertilizers and implements are additionally introduced in equation (2). The analysis indicates that 71.2 per cent of the variance in output per acre was explained by irrigation and labour in 1951, 71.3 per cent in 1961 and about 90 per cent in 1971. Labour was an important variable in each year, its regression coefficients, as obtained from equation (2), were 0.552 in 1951, 0.551 in 1961 and 0.593 in 1971. The coefficients of irrigation were also statistically significant, suggesting that irrigation makes a significant contribution to output, although less than that of labour.

As additional variables are introduced, the regression coefficients of labour show some decline (and are statistically insignificant in 1951), but still retain higher values by comparison with the coefficients of other inputs in the base years. Irrigation comes next in importance, but the value of its regression coefficient was very low and the *t*-value suggested that it is also insignificant; this is perhaps due to the complication introduced by auto-correlation between irrigation and implements. The regression coefficient of implements was significant in 1961 and 1971; the elasticity values they suggested were comparatively low, being 0.18 in both 1961 and 1971.

The results in table 71 (c) show the respective contribution of independent variables to output per worker. The variables included in equation (1) are land and irrigation. Fertilizers and implements are taken as additional variables in equation (2). Land and irrigation explained between themselves 54 per cent of the variance in output per worker in 1951, 59 per cent in 1961 and 79 per cent in 1971. The coefficients of land were statistically insignificant and uniformly low and, in fact, negligible in 1971. Irrigation was the factor of major consequence. The elasticity of output per worker with respect to irrigation was 0.330 in 1951, 0.210 in 1961 and 0.382 in 1971. In the second set of equations, fertilizer appeared a negligible factor, although this should not be interpreted literally in view of the complementarity between water and fertilizers. Irrigation remained the major explanatory variable in 1951 and 1971, but not in 1961. Equation (2) gave a statistically significant regression coefficient of land with a value as high as 0.438 in 1961. This appears intriguing, however, when it is observed that the simple correlation coefficient of output per worker with irrigation was 0.773 and that with land was only 0.353 in 1961 (table 70). The coefficients of implements were statistically significant in 1961 and 1971, but not in 1951. The elasticity of output per worker with respect to implements was 0.327 in 1961, but it fell to 0.177 in 1971. It is likely that tractors and other equipment have expanded far too rapidly relative to the complementary input, mainly land, to sustain their optimal utilization.

To sum up, labour was the factor of greatest consequence in whatever combination of inputs was considered, except for a minor deviation in equation (2) of 1971 when irrigation took precedence over it. The elasticity coefficients of output with respect to labour were high; they showed an increase between 1951 and 1961, but there was a drop in the values in 1971 compared with 1961. It may be that labour expanded far too rapidly in relation to cropped area between 1961 and 1971. However, when output per acre was considered, uniformly high coefficients of labour were observed at each point of time. Estimates of marginal products of labour rose from Rs 285 in 1951 to Rs 555 in 1961 and to Rs 899 in 1971 in the first set of equations in table 71 (a); the corresponding values indicated in table 71(b) were Rs 338, Rs 461 and Rs 701. Irrigation ranked next in importance to labour; its estimated marginal products were Rs 104, Rs 107 and Rs 146 in the first set of equations in table 71(b). The marginal products of labour and irrigation multiplied by the respective means of these inputs per acre summed up to Rs 125 and Rs 220 in 1961 and 1971 respectively. While no definitive statement is possible without a more detailed probe into the effects of the more complex combinations including some other inputs on output, one may conjecture that the additional inputs would result in a more rapid growth of output relative to that of the inputs. Whether this would imply an upward shift in production function or increasing returns to scale remains to be verified. The new seed-water-fertilizer technology that came in the late 1960s perhaps points to greater plausibility of the first alternative.

Conclusion

There have been large-scale programmes of land reclamation and irrigation works which resulted in extensions of net sown area in some districts of Punjab as well as in growth of work force and total output. New opportunities have also been thrown up through the development of infrastructure and extension services. The people of Punjab have responded to this and have exploited the opportunities with alacrity and effort to their maximum advantage. This is reflected in the results obtained from the regression equations which showed maximum elasticity coefficients of labour and rise in its marginal productivity over the successive decades. This acquires special significance in the context of diminishing acreage available per worker. Land is positively related to output, but the elasticity of its contribution pales into insignificance when considered in conjunction with other inputs. This confirms the diminishing role of available land potential per prospective entrant into agriculture (LPE) in explaining variations in population growth. Taking LPE as a measure of the income-producing possibilities per prospective worker and net sown area per worker as a proxy for what could meet his consumption requirements at given levels in the base period, the ratio between the two fell uniformly below unity, suggesting that all the districts had become areas of "economic stress" by 1971. Comparisons across the districts in terms of absolute values of LPE also indicated very weak association with growth rates of rural population. However, there was a close association between the growth rates of output and those of rural population. This suggests that potential land availability ceases to be an index of "economic opportunity" for the farm population in a phase of rapid capital accumulation and technological progress.

Population growth is the main source of labour supply. The obvious association between growth rates of rural population and percentage increase in agricultural work force was observed, although the relationship was not always very strong. However, it was remarkably strong in areas of rapid agricultural development. In fact, there were several districts in Punjab where agricultural labour force increased faster than rural population, suggesting in-migration as well as the possibility of a reverse movement of labour from industry and services into agriculture. Growth rate of agricultural work force was very closely associated with increase in agricultural output. Interestingly, the latter had uniformly outpaced the former, resulting in a rise in labour productivity which is more impressive in some districts than in others. Also, several districts with high rates of increase in agricultural labour showed equally greater rises in labour productivity, although the trend was not uniform.

Finally, close association between growth of rural population and improvements in economic welfare measured in terms of changes in *per capita* output was observed. The phenomenal rates of rural population growth in Hissar, Karnal and Patiala (48 per cent, 41 per cent and 40 per cent respectively) in 1951-1961 were associated with record increases of 71 per cent **36 per cent and 94 per cent** in *per capita* output.[3] (table 72). Again, in 1961-1971, Karnal, Ludhiana, Gurdaspur, Kapurthala, Bhatinda and Sangrur combined high rates of increase in *per capita* output, ranging from 34 to 90 per cent, with population growth rates above the

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[3] The maximum increase in *per capita* output in 1951-1961 was recorded by Mahendragarh with a somewhat lower population growth rate of 23 per cent, but this was partly due to the low base of output.

Table 72. Percentage change in rural population and *per capita* output in the districts of Punjab, 1951-1971

District	Percentage change in rural population		*per capita* (rural) output				
	1951-1961	1961-1971	1951	1961	1971	1951-1961	1961-1971
Hissar	48.0	36.80	164	281	277.14	71.3	-1.44
Rohtak	26.3	21.72	156	186	219.37	19.2	18.13
Gurgaon	25.1	33.65	103	134	155.54	30.0	15.90
Karnal	41.3	32.66	178	242	326.45	36.0	34.51
Ambala	21.8	19.51	139	170	169.56	22.3	-0.20
Hoshiarpur	9.9	21.02	92	117	157.89	27.2	35.41
Jullundur	12.6	14.97	129	166	262.81	28.7	58.13
Ludhiana	17.7	29.44	170	211	410.66	24.1	94.90
Ferozepur	23.0	17.61	235	261	359.80	11.1	37.75
Amritsar	10.4	20.61	146	155	266.63	6.2	71.80
Gurdaspur	14.6	23.23	124	131	203.69	4.8	56.32
Bhatinda	28.9	26.40	223	275	407.38	23.3	48.0
Kapurthala	14.7	25.31	176	165	289.98	-6.5	74.35
Mahendragarh	22.6	23.45	63	130	143.85	106.3	10.6
Patiala	39.5	13.21	130	252	345.63	93.8	36.9
Sangrur	27.3	23.65	196	244	337.18	24.5	38.2

state average, ranging from 23 to 33 per cent. Gurgaon and Hissar appeared as two major exceptions, but that was more apparent than real. In Gurgaon, crop output did not capture the entire increase in its income for two reasons: (a) it showed a remarkable increase in the proportion of non-agricultural work force which is in contrast to the general trend in the state and (b) the adjoining district of Delhi provided the market opportunities and contributed to diversification of output, some of which is outside the crop basket included in our computations. Hissar is the only district with an increase of 37 per cent in rural population and a small decline of 1.4 per cent in *per capita* output but Hissar had attained the highest level of prosperity in 1961.

To sum up, during 1951-1961, population movements were partly induced by reclamation of new lands although they contributed in turn to much higher rates of rise in productivity. In 1961-1971, however, the rapid growth of population in several districts was accompanied by equally high rates of increase in *per capita* output, in spite of a uniform decline in the land-labour ratio. Population growth and movements thus seem to have made a positive contribution to exploitation of opportunities for agricultural development in Punjab instead of being an obstacle to economic betterment. However, insights into the interrelationship between population growth and agricultural development can be gained from similar studies for other regions of the country.

B. ORISSA

The data on growth of rural population and male workers in agriculture in the districts of Orissa are given in table 73. Unlike Punjab, Orissa did not show any consistent relationship between trends in rural population and those in male workers in agriculture. While the rural population increased by 17.6 per cent in 1951-1961, agricultural male workers increased by 33 per cent. In the next decade, on the other hand, an increase of over 22 per cent in the rural population was accompanied by only an 18 per cent addition to the number of male workers in agriculture.

In 1951-1961, the growth rates of agricultural workers were higher than the rates of increase in rural population in nearly all the districts. In Koraput, work force increased by 60 per cent as against an increase of only 18 per cent in rural population. The relationship appeared to have been reversed in the next decade, although the trend was far from uniform. In 1961-1971, in Koraput, Dhenkanal and Cuttack, growth rates of 32, 27 and 24 per cent in rural population were associated with percentage increases in male workers in agriculture of the order of 31, 25 and 22 per cent respectively. In Balasore and Sundergarh, however, male workers in agriculture increased by only 17 per cent and 11 per cent respectively, as against an increase in rural population of 31 per cent and 27 per cent. Such erratic trends may be partly attributed to changes in the economic concepts and definitions of workers adopted by the census. In 1951, a person was identified as self-supporting person or earning dependant (the two categories combined constituting the work force) if he or she secured a regular income. Evidently, a large proportion of unpaid family workers were omitted under the income criterion and, since they comprise a sizable section of the rural work force in a backward region like Orissa, the 1951 Census framework resulted in some under-enumeration of workers in the state. The definition in the 1961 Census, on the other hand, included in the work force all persons who have had regular work for more than one hour a day throughout the greater part of the working season. The relatively high rate of increase in work force in 1951-1961 is, therefore, at least partly due to conceptual problems. Unfortunately, the definition of "worker" was again revised in 1971 and included only those persons whose main activity was economically productive work. This evidently excluded those for whom work was a secondary activity, and resulted in under-estimates of work force in 1971 and, consequently, in relatively lower rates of growth of workers.

Table 73. Percentage increase in rural population and male workers in agriculture in the districts of Orissa, 1951-1971

District	Percentage increase in rural population		Percentage increase in male workers in agriculture	
	1951-1961	1961-1971	1951-1961	1961-1971
Sambalpur	11.6	17.1	16	19
Sundergarh	16.4	27.0	32	11
Keonjhar	23.8	24.8	36	14
Mayurbhanj	15.2	18.2	25	11
Balasore	25.1	30.9	46	17
Cuttack	18.7	24.0	20	22
Dhenkanal	22.6	26.5	25	25
Baudh-Khondmals	12.6	18.1	23	22
Bolangir	16.4	15.6	33	17
Kalahandi	16.4	12.9	35	16
Koraput	18.0	31.9	60	31
Ganjam	13.9	18.4	35	21
Puri	16.4	22.1	28	15
Total	17.6	22.4	33	19

Note: In figures 7 and 8, the following abbreviations are used for the names of the districts of Orissa:

Sr	Sambalpur	Pni	Baudh Khondmals
Sh	Sundergarh	Br	Bolangir
Kr	Keonjhar	Ki	Kalahandi
Mj	Mayurbhanj	Kt	Koraput
Be	Balasore	Gm	Ganjam
Ck	Cuttack	Pri	Puri
Dl	Dhenkanal		

While the conceptual changes have distorted the growth rates of the work force to some extent, it may still be of some interest to examine whether interdistrict variations in agricultural work force are in any way related to factors associated with agricultural growth.

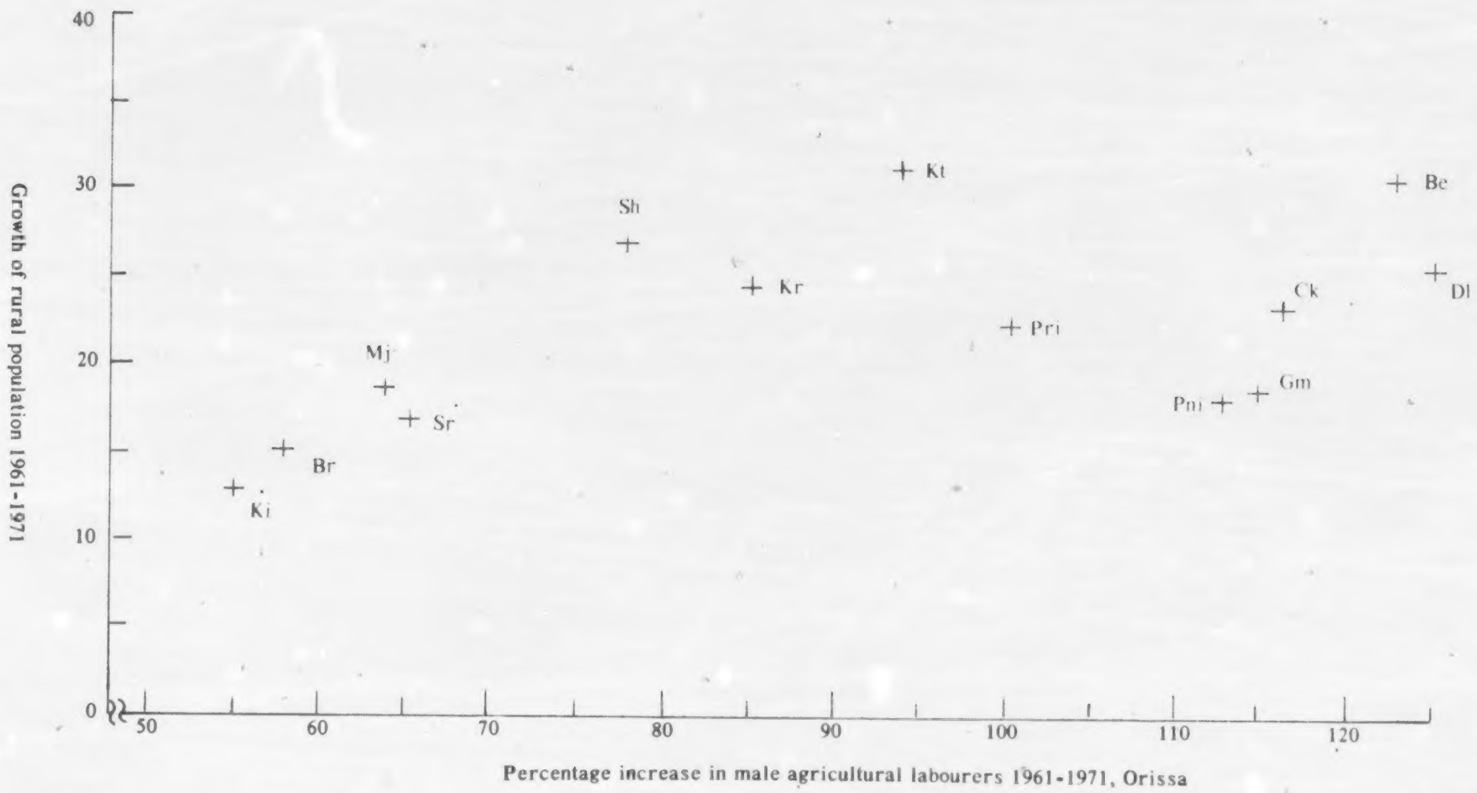
The bivariate distribution of districts by output growth and percentage increase in male workers in agriculture show no meaningful association in the decade 1951-1961 but a high degree of positive relationship between the two variables in 1961-1971. This is also reflected in the association between the growth of agricultural output and the percentage increase in wage-paid labour on the farm.

The relationship between growth of work force and the factors associated with agricultural growth may now be examined. Data on the extension of net sown area show that the absolute magnitude of increase in net sown area (about 5 per cent at the state level) was far too small to explain the acceleration of population growth in Orissa. At the district level, there were somewhat larger increases in area in some districts. However, there was no systematic association between inter district variations in net sown area and those in work force. Thus, Koraput, Dhenkanal and Ganjam showed relatively larger gains in net cultivated area (14 per cent in Koraput and 7 per cent each in the other two districts) and also above-average growth rates in work force (31 per cent, 25 per cent and 21 per cent respectively). On the other hand, Keonjhar, Mayurbhanj and Sundergarh also showed relatively larger increases in net cultivated area, but recorded significantly lower rates of increase in

Table 74. Bivariate analysis of relationship between percentage increase in male workers in agriculture and growth rates in agriculture in districts of Orissa, 1951-1971

Percentage increase in male workers	Growth rates in agriculture			
	1951-1961		1961-1971	
	Above median	Below median	Above median	Below median
Above median	2	5	6	1
Below median	5	2	1	6

Fig. 7. Districts of Orissa according to percentage increase in male agricultural labourers and growth of rural population, 1961-1971



work force (ranging from 11 to 16 per cent). Baudh Khondmals and Cuttack experienced high rates of increase in work force, (22 per cent each), but area gains of only 3 per cent. In Orissa, as in Punjab, the districts with relatively large area gains perhaps attract more workers, although it did not appear to be always the case. Also, several districts recorded a relatively rapid increase in work force without a perceptible increase in net cultivated area.

In Orissa, area under crops increased much faster (16 per cent) than net sown area (3 per cent) in the state as a whole, suggesting a tendency towards more intensive use of land. However, the increase was concentrated in a few districts, being as high as 70 per cent in Ganjam, 23 per cent in Koraput, 22 per cent in Cuttack and 16 per cent in Balasore. These were also districts which experienced a relatively rapid increase in work force. This indicates that workers play an active role in raising the intensity of cropping. Dhenkanal and Baudh Khondmals recorded higher growth rates in work force with only moderate gains in cropped area; however, they enjoyed the benefit of marked increase in productivity.

Increase in output per acre (a convenient summary measure of the intensity of land use) shows the expected association with growth of agricultural work force. The cross-classification of districts by changes in productivity (per acre) and percentage increase in workers (figure 8) shows that six districts recorded above-median values on both the variables. Balasore, Cuttack, Dhenkanal, Baudh Khondmals, Puri and Sambalpur recorded larger increases in yields than the state average and also a relatively higher growth of work force. Figure 8 shows the rise in productivity (per acre) against the growth of work force; it suggests a significant positive association but indicates that a part of the variability in output per acre is left unexplained by growth of work force.

While the data for 1951-1961 have not been analysed at all for reasons of conceptual non-comparability of the work force in 1951 and 1961, the relationships observed in the decade 1961-1971 are also to be interpreted with due caution on the same ground. However, the absolute figures at a point of time are likely to be less sensitive to such biases than changes over time. More meaningful results may, therefore, be derived from cross-sectional comparisons. The respective significance of land, water and fertilizer along with labour is assessed by using the multivariate regression technique. The analysis is confined to 1971 for which the agricultural data are considered to be reliable. The correlation matrices are presented in table 75 to give a preliminary view of the relationships between different variables.

Table 75. Correlation matrices, Orissa, 1971

Variables	Dependent variable	Independent variables			
	Output	Gross sown area	Gross irrigated area	Agricultural workers (male)	Fertilizer
	Y	X_1	X_2	X_3	X_4
Y	1.000	0.977	0.823	0.971	0.871
X_1		1.000	0.751	0.967	0.849
X_2			1.000	0.765	0.909
X_3				1.000	0.820
X_4					1.000

Variables	Dependent variable	Independent variables		
	Output per acre	GAI/GAS	Agricultural (males) (per acre)	Fertilizers per acre
	Y^1	X_1	X_2	X_3
Y^1	1.000	0.691	0.161	0.562
X_1		1.000	-0.002	0.774
X_2			1.000	-0.346
X_3				1.000

Variables	Dependent variable	Independent variables		
	Output per per male worker in agriculture	GAS per workers	GAI per worker	Fertilizer per worker
	Y^{11}	X_1	X_2	X_3
Y^{11}	1.000	0.639	0.648	0.743
X_1		1.000	0.185	0.442
X_2			1.000	0.809
X_4				1.000

The simple correlation values show a highly significant relationship between variations in total

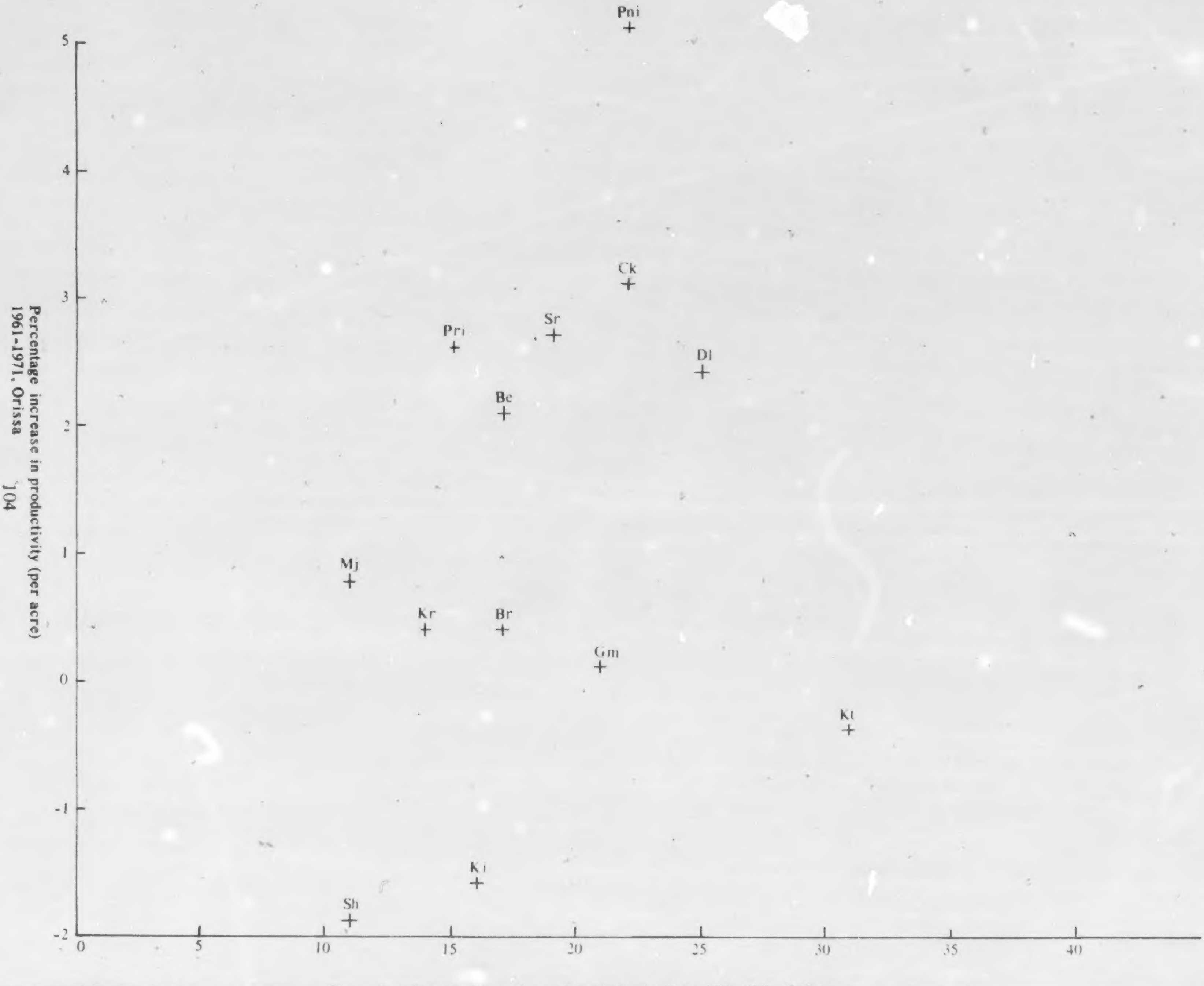


Fig. 8. Districts of Orissa according to percentage increase in male workers in agriculture and in productivity, 1961-1971

output and in various inputs. Moreover, there is a high level of auto-correlation between some of the inputs, notably those between land and labour and between irrigation and fertilizer inputs. Output per acre is significantly related to irrigation and fertilizer inputs, but shows a very low value of correlation with labour input per acre. Output per worker in agriculture also shows positive correlation with land, water and fertilizer inputs per worker.

To assess the relative significance of different inputs in explaining variations in output, log-linear regressions are fitted to the data for 13 districts in Orissa in 1971. The results are presented in table 76. Table 76 (a) explains variations in total output; 76(b) and 76(c) give the results for output per acre and output per male worker respectively. The regression coefficients measure the elasticity of output with respect to the independent variables. The *t*-values given in parentheses indicate the statistical significance of the regression coefficients.

It is evident from tables 76 (b) and 76 (c) that the regression equations yield some significant results. The first set of regression coefficients in table 76 (a) relates to all the inputs included here. It gives a high coefficient for land, indicating that the elasticity of output with respect to land is as high as 0.677. The coefficients of other inputs are not statistically significant, but it is likely that they are distorted by the high degree of auto-correlation between land and labour and also that between fertilizer and water. As land is deleted, a high value of the elasticity of output with respect to labour is obtained. The over-all explained variance is 97 per cent in the first set and 94 per cent even after land is excluded.

The results in table 76 (b) show that only 32 per cent of the variance in output per acre is explained by labour, water and fertilizer inputs, and none of them has significant regression co-

Table 76. Parameter estimates for output in Orissa, 1968-1971

Dependent variable	Independent variables				R^2	Degrees of freedom
	Gross sown area	Grossirrigated area	Male workers in agriculture	Fertilizrs		
Total output			Table 76(a)			
Eq. (1)	0.6770 (2.6338)	0.1190 (1.6254)	0.3770 (1.4238)	-0.0213 (-0,3648)	0.9663	8
Eq. (2)		0.0505 (0.5733)	1.0046 (6.7605)	0.0557 (0.8530)	0.9441	9
			Table 76(b)			
Output per acre						
Eq (1)		0.0879 (1.1458)	0.2689 (0.9662)	0.0349 (0.6833)	0.3191	9
Eq. (2)		0.1312 (3.1062)	0.1654 (0.7281)		0.3366	10
			Table 76(c)			
Output per worker						
Eq. (1)	0.6082 (2.2083)	0.0879 (1.1458)		0.0349 (0.9662)	0.5863	9
Eq. (2)	0.5049 (1.9104)			0.0832 (2.8349)	0.5734	10
Eq. (3)	0.7034 (3.0438)	0.1312 (3.1062)			0.6084	10

Note: All independent variables in (b) are divided by gross sown area and those in (c) by the number of male workers in agriculture.

efficients. However, when fertilizer is dropped, irrigation appears as a significant input, but the elasticity coefficient is only 0.13. The coefficient of labour remains low and statistically insignificant.

In table 76(c), land again emerges as a statistically significant factor in explaining variations in output per worker and bears a regression coefficient as high as 0.608. Fertilizer becomes a significant variable when irrigation is dropped from the equation, but its coefficient remains low. Land still retains a coefficient as high as 0.505, although it is not statistically significant. The third combination includes land and water. The regression coefficients of both the variables are significant and their values improve, suggesting that the contribution of land to labour productivity in agriculture is reinforced by the availability of irrigation facilities.

To sum up, land is a factor of greatest consequence in the agricultural output and its role in agricultural productivity is further improved with the increase in irrigation facilities. In the light of this finding, the low priority accorded so far to land reclamation programmes in the state becomes a matter of concern, particularly so when extensive areas of arable land are lying unused. Further, while the regression coefficient of labour is statisticcally significant in explaining variance in total output (when land is excluded), it becomes insignificant when variations in output per acre are considered along with changes in labour input per acre.

The positive association between the increase of work force in agriculture and growth of agricultural output in the decade 1961-1971 suggests the active role of workers in agricultural development, although no firm conclusion can be drawn in this regard in the light of the regression results given in table 76 (c).

Conclusion

Orissa is an agriculturally backward but not an overcrowded state. It has extensive areas of arable land lying unused. However, no programmes of large-scale land reclamation have been undertaken in the state so far. The area under principal crops, however, has increased much faster than the net sown area, but only in a few districts. Some districts have also experienced a significant increase in output per acre.

The range of interdistrict variations in population growth was comparatively limited in 1951-1961 but widened in 1961-1971, suggesting the role of population movements from one district to another. Population growth is associated with increase in the number of workers in agriculture. The increase in the latter was much greater than the former in most of the districts in the decade 1951-1961, but the position was reversed in 1961-1971. Such erratic changes are mainly due to changes in definition of workers from one census to another. The association between growth of rural population and agricultural work force was rather weak in 1951-1961. Some relationship, however, was observed in 1961-1971 between the changes in the two variables. Significant correlation was observed between increase in wage-paid labour (whose enumerations was less biased by changes in census definition) in agriculture and that in rural population in the decade 1961-1971. This coupled with the fact that rapid increase in agricultural (wage-paid) labour is originally associated with high rates of increase in agricultural wages and/or high level of wages yields results of some analytical significance. It appears that employment opportunities on the farm stimulate population movements.

A close association was observed between increase of work force and growth of output in Orissa in 1961-1971. Ordinarily, the districts with relatively rapid growth of work force showed improvement in the intensity of land use. The area under principal crops increased much faster than the net sown area, implying a rise in the intensity of cropping. In most of these districts there was also an increase in yields per acre. Cross-sectional comparisons showed a very high correlation between total output and labour inputs in 1971, but the correlation became very weak between output per acre and labour input per acre. It may be that there is too much labour in relation to land or that labour remains inefficiently distributed in relation to land resources in different districts, in spite of some tendency for workers to move into districts with relatively rapid increase in cropped area. However, land is a significant variable in explaining variability in output and labour productivity. The neglect of land reclamation programmes on an appreciable scale therefore appears as an obvious gap in the state policy of Orissa.

The relatively rapid increase in agricultural work force was found to be associated with increase in productivity in all the districts except Koraput. In Cuttack, Ganjam and Baudh Khondmals, the rise in labour productivity was as large as 29 per cent, 43 per cent and 33 per cent respectively. On the other hand, output per worker declined in Bolangir, Kalahandi, Keonjhar and Sundergarh, even though the increase in work force was low to moderate.

As indicated in table 77, there is a wide range in agricultural output per person of rural population from Rs 43 to Rs 125 in various districts. Between 1951 and 1961, there was a marked increase in *per capita* output, but it varied widely from 11 to 102 per cent. There was no systematic association between growth rates of rural population in 1951-1961 and rise in agricultural output levels during the decade. The range in *per capita* agricultural output in 1961 was about as large as that in 1951. In 1961-1971, rapid population growth was accompanied by a significant increase in *per capita* agricultural output in Cuttack and Ganjam, but resulted in an absolute decline in Keonjhar and Koraput. At the same time, in Kalahandi and Sundergarh, *per capita* agricultural output declined in spite of relatively low rates of population growth. Thus, population growth does not appear to be a necessary obstacle to economic betterment, although in some districts its depressing role may be noted.

AN OVERVIEW

The study is focused on interrelationship between population and agricultural change. It is based on the analysis of demographic and agricultural data of two states in India: Punjab (as it existed at the time of the 1961 Census) for the period 1901-1971 and Orissa for a more limited period. Since no field survey was envisaged, limitations of the data available from secondary sources impose certain constraints on the scope of the study.

Punjab is a comparatively developed state and is known for having made rapid strides in agriculture in recent times. Orissa is backward and comparatively stagnant. Both states share with India as a whole and with the developing countries the trend toward accelerated growth of population. Punjab experienced acceleration earlier than Orissa; attained a peak in the growth rate in the decade 1951-1961 and showed a marginal decline in the following decade. In Orissa, the rate of growth in 1951-1961 was only two thirds of that in Punjab but rose sharply and attained a comparatively higher level in 1961-1971.

The main factor causing differences in population growth between the two states is the differential mortality. Orissa did not in the past, and even in the recent period, experience as fast a decline in death rate as in Punjab. The public health system and sanitary measures which provide good opportunities for reduction in mortality have not spread very well in Orissa. There is still a sizable unexploited potential for death control in Orissa which may very well be eventually realized. This means that high rates of population growth will persist for some time at least.

Significant interdistrict differences in rates of population growth were observed in composite Punjab, particularly in recent decades. Similar

Table 77. Output per worker and per person of rural population in the districts of Orissa, 1951-1971

District	Output per male worker in agriculture			Output per person of rural population				
	1961	1971	percentage change 1961-1971	1951	1961	1971	percentage change 1951-1961	percentage change 1961-1971
Sambalpur	574	644	11	116	149	171	24	14
Sundergarh	592	375	-37	125	154	85	23	-45
Keonjhar	466	440	-6	105	117	101	11	-14
Mahurbhanj	359	399	11	77	90	94	17	4
Balasore	379	444	17	85	97	102	15	5
Cuttack	466	600	29	79	100	125	28	25
Dhenkanal	573	604	5	83	133	138	62	4
Baudh-Khondmals	298	395	33	118	75	103	37	37
Bolangir	507	464	-8	84	128	128	52	0
Kalahandi	593	468	-21	79	158	129	102	-18
Koraput	495	451	-9	120	136	123	13	-9
Ganjam	392	560	43	43	80	117	90	46
Puri	471	521	11	83	110	114	33	4
Total	473	509	8	87	115	121	32	5

differences were noted in Orissa only in 1961-1971. Available evidence seems to suggest that the variations in birth and death rates are comparatively insignificant. The major factor causing differences in growth rates of population of districts is net migration. However, variations in birth rates during the decade 1961-1971 in Punjab are of some significance, and indications of fertility decline in some districts compared with their levels in the preceding decade is of even greater interest. The limited availability of data poses certain constraints as far as discerning trends is concerned, but consistency checks, such as comparing the fertility estimates with child-woman ratios, give some confidence in the trend, if not in the precise magnitudes. No such trend is yet discernible in Orissa. Analysis of agricultural data (on output, acreage and productivity) reveals comparative stagnation in Punjab from 1901 to 1941, a modest growth in 1941-1951 and a marked acceleration in the two succeeding decades. Agricultural growth was rather impressive even in Orissa during 1951-1961 (although a part of it may be statistical), but sagged a little in 1961-1971. The trends in the post-Independence period reflect the influence of state policies directed towards agricultural development through land reclamation, irrigation, extension services and the supply of inputs like fertilizers and high-yielding variety seeds. Increase in cropped acreage (inclusive of multiple cropping) was the major component of growth of crop output in Punjab in 1951-1961, while the yield effect was dominant in the next decade. In Orissa, rise in yield was more important in 1951-1961 and expansion of acreage in 1961-1971.

Striking variations in levels of productivity were noted among the districts of Punjab at each point of time. However, cross-temporal comparisons showed no consistent trend until 1941. In 1941-1951 and 1951-1961, there was a marked inverse relationship between the base level productivity and change over time. There was also a shift from the low-value to high-value crops between 1951 and 1961 in the districts which had an inferior crop pattern in 1951. Moreover, the districts which had a low proportion of arable land under crops in 1951 showed a remarkable expansion of cropped acreage over the decade due mainly to the increase in irrigation facilities. The pattern changed significantly in 1961-1971 with the introduction of the new seed-water fertilizer technology. Many districts which were agriculturally prosperous in the initial periods and had potential for high growth but suffered due to static technical conditions took a lead in the adoption of the new technology and recorded phenomenal rates of growth in output.

In Orissa, there were significant interdistrict differences in productivity as well as in rates of agricultural growth in both 1951-1961 and 1961-1971, but they showed no regular pattern. Rice was the dominant crop in all the districts of Orissa and, although the output of non-food crops like oilseeds and fibres increased significantly in some districts, their share in both total output and acreage was small throughout the state. Curiously enough, in some districts the allocative pattern of farm land showed a tendency towards the substitution of low-value cereals like ragi and maize for rice.

The hypothesis of special interest for the present study is the mutual response of demographic and agricultural variables to "population pressure" or what Easterlin has termed levels of "economic stress" or its inverse "economic opportunity". To give a dynamic content to the concept, it is measured in terms of available land potential per prospective entrant to the agricultural work force in a given period. A positive relationship between potential land availability and population growth was expected; the causal nexus being possibly provided by the prospects of increase in area under cultivation and output which would induce migration to these areas (and perhaps also encourage larger families to a small extent, and bring about reduction in death rate). The hypothesis is strongly confirmed only by the experience of Punjab in the decade 1951-1961 when high rates of agricultural growth were largely obtained through the expansion of acreage. The trends in other decades did not support the hypothesis. However, if one keeps in mind the nature of causality implied in the particular form in which the concept of "economic stress" is specified for empirical verification, this conclusion is fairly obvious. Evidently, *ex ante* measures of the levels of "economic stress" or "economic opportunity" would have to be formulated differently in time and space where agricultural growth is dependent on factors other than acreage expansion.

The relationship between population growth (and net migration rates in so far as they account for the interdistrict differences in rates of population growth) and agricultural conditions and changes therein appears to be positive in Punjab. In the period of agricultural stagnation, the growth of population was very small and there was also a relatively small volume of migration, with a general over-all trend indicating movement into the districts with relatively high levels of agricultural prosperity. The decades of accelerated growth in agriculture witnessed a significant increase in population growth; the correspondence between the two variables was very close, particularly in 1951-1961.

Interdistrict differences in population growth attained perceptible magnitudes in Orissa only in the decade 1961-1971. They do not show any systematic correspondence to rates of agricultural growth but appear to be positively related to increase in wage-paid employment in agriculture and also in wage rates. Given the small increase in net sown area and limited prospects for people to acquire land rights, they tended to move into areas which offered better opportunities for wage employment on the farm. Moreover, such movement did not appear to retard the rise in agricultural wages.

In the absence of firm estimates of birth rates, it is not possible to establish any clear relationship between variations in fertility levels and levels or rates of agricultural development. There is fairly reliable evidence, however, of decline in birth rates in some, if not all, of the prosperous districts of composite Punjab in 1961-1971. There is no such indication in any district of Orissa. Cross-temporal comparisons bring out a positive relationship between population growth and increase in labour supply in Punjab which may be expected when migration is a major factor accounting for interdistrict differences in rates of population growth. However,, the changes in the concepts and definition of labour force from one census to another distort the analysis and pose problems of comparability. All the same, districts of Punjab which experienced high output in agriculture also experienced high growth in agricultural work force. This may suggest that accelerated growth of agriculture has encouraged a reverse movement of workers from the industry and service sector into agriculture. In the case of Orissa, the effect of changes in the definition of workers appears to be strong and no clear-cut trend emerges. However, the districts with a relatively rapid growth of agricultural work force showed improvement in the intensity of land use.

An interesting contrast is observed in the role of labour supply in agricultural production between periods of stagnation (1901-1951) and those of accelerated growth (1951-1971). The role of labour supply appeared insignificant in the earlier period and significantly large in the recent decades. Production functions of the Cobb-Douglas type fitted to the cross-sectional data on agriculture in Punjab in 1951, 1961 and 1971 gave generally higher elasticity coefficients for labour than for other inputs such as irrigation, fertilizer and implements. Also, the marginal productivity of labour rose over time. In Orissa, however, it is land and water (irrigation), and not labour, that are the inputs of significance in explaining variations in agricultural output.

The direction of causality implied in the observed relationship between population and agricultural change is not easy to determine. The districts in Punjab which have ben[illegible] from the state-sponsored and/or subsidized programmes of land reclamation and irrigation have experienced relatively favourable rates of net migration (either as in-migration or as lower rates of net outflow), although there are a few exceptions. At the same time, similar, but perhaps less dramatic population movements are also observed in districts without a significant expansion of cropped acreage. The positive relationship between population and agricultural change, however, does give some indication that, wherever people have moved in large numbers, they have taken advantage of the available agricultural opportunities with alacrity and effort. Migration appears to have made positive contribution to agricultural efficiency in Punjab. The production function analysis lends further support to the active role of workers in contributing to the accelerated growth of agriculture in Punjab. The growth of population has been relatively rapid since 1951, but all districts recorded a positive increase in *per capita* output. In fact, some districts with a relatively higher growth of population recorded even larger increases in *per capita* output. While it cannot be firmly concluded from available evidence that population is a positive force in agricultural development, it can be stated with some confidence that population growth in Punjab is not yet an obstacle to economic growth.

Orissa, which is a relatively backward state in India and which has not experienced the rapid growth in agriculture that has been the base in Punjab, presents no consistent pattern in *per capita* agricultural output and rate of population growth. Some districts with a relatively rapid growth of population showed larger increases in *per capita* output, but some of the other districts even recorded the opposite trend. Also, some districts with slow population growth even experienced a decline in their *per capita* agricultural output. The trend in Orissa is thus unclear.

Indications of decline in birth rates in some of the prosperous districts of Punjab suggest that Punjab provides an excellent laboratory for testing some hypotheses on interaction between demographic and economic variables with significant policy implications. A few promising areas of research that are pertinent to the subject of the present study but outside its scope partly because of non-availability of data are briefly outlined below.

The issues in economic development for their implications in demographic behaviour are:

1. The process of agricultural development has been well under way in Punjab for some time. Is it now at a stage of sustained take-off or is there any tendency for it to reach a plateau? Is it being supported by external forces or is the momentum sustained by forces generated internally?

2. Is agricultural development contributing to diversification of the economy and a process of over-all economic modernization?

3. What are the effects of agricultural development on employment and income distribution and what are the trends in mass participation in the process of modernization of the economy?

4. What are the trends in allocation of rising income between consumption and investment, between current consumption and consumer durables, and between investment in human capital and that in material capital?

5. What are the trends in the decision of the head of the family farm in the allocation of family labour time between on and off-the-farm activity, indicating how far he finds a large family a source of or conducive to current economic prosperity?

Answers to these questions may help in assessing the extent to which people are developing wider perspectives and an outlook for planning their personal living.

Certain issues in the area of fertility which are of relevance in the area of agricultural change and population growth are:

1. In the phase of incipient decline in fertility, analysis of differential fertility may yield very fruitful results. The economic and social factors for classifying population groups should be carefully looked into for their amenability to policy manipulation. They should, in particular, be tied to the elements in economic development outlined above.

2. Existing data on fertility are inadequate for the accurate measurement of its levels. Data on fertility should be collected through carefully planned sample surveys, and include the reproductive history of couples to provide a basis for the analysis of trends.

3. Also, it would be useful to examine and assess the decline in the birth rate attained before the official family planning services came into existence and whether the services have generated enough demand among people or whether the demand is due more to forces external to the organization of the family planning services.

Annex I
ESTIMATION OF VITAL RATES FOR PUNJAB
1951-1971

A. ESTIMATES BY REVERSE SURVIVAL METHOD

The data base for estimating vital rates by this method consisted of life tables for males and females for 1951-1960 for India as a whole, prepared by the Census Actuary. In addition to highlighting the regional variations in mortality experiences, six zonal life tables were prepared. The life table for the northern zone (Punjab and Rajasthan) has been used here. The single-year smoothed age distributions available for Punjab from both the 1951 and the 1961 censuses form an important part of the data base.

The method involved projecting the smoothed 1951 census population of Punjab to 1961 separately for males and females by using the northern zone life table. In 1951, population aged 0-4 was taken as enumerated and smoothing was done for population aged 5 and over. Hence, projected population aged 15 and over was considered as relevant for comparison with the actual 1961 smoothed population. Projected population was found to be in excess of the actual by 5.9 per cent in the working ages 20-44 in the case of males and in age group 20-39 in the case of females. For other ages, it was slightly in deficit. The projected population aged 15 and over was blown up to total population by multiplying it with the ratio of total population to the population aged 15 and over in the actual smoothed 1961 census age distribution. The difference between the blown up population and 1961 actual population came out as +331,138 for males and +170,842 for females. Within practical limits these figures are comparable with the actual net out-migration of 299,307 males and 266,499 females. Thus, the northern zone life table was found to be reasonably appropriate for estimating births in the state during 1951-1960.

The smoothed population below age 10 in single years was projected backward to obtain births in the preceding years. The average of the 1951 and 1961 census populations, without adjustment for migration, was used to calculate the decade birth rate. This procedure assumes the absence of fertility differentials in the migrant population. The estimated birth rate for 1951-1960 obtained by this method is 41.7. Since the exponential growth rate is 25.8, the death rate works out at 15.9.

1. Birth and death rates by districts

The Indian northern zone life table 1951-1960 was used to estimate births in the districts in 1951-1960. Uniformity of mortality by age in the different districts thus implied is not strictly valid. However, in the absence of appropriate district life tables, this was found expedient for obtaining mortality estimates. The unsmoothed age distribution of the districts is greatly distorted. It was assumed that the pattern of distortion by age in the districts was the same as in the state data. This is a plausible assumption, since in each case the main cause of distortion is lack of knowledge of correct age. The census publication "Age Tables - 1961" amply bears out the uniformity of distortion pattern in the census age returns of different states. This uniformity applies to district population also. The district age distribution was smoothed in a rough and ready way by multiplying the enumerated figures by the ratio of smoothed to unsmoothed state populations for each age.

2. Estimates for the 1961-1971 decade

Vital rates estimated on the data available from the 1971 Census suffer from three limitations: (a) migration data were not available till the time of writing of this report, (b) life tables for 1961-1971 have not yet been prepared by the Census Actuary and (c) age data are lumped together for the age group 0-14 and not provided separately for single or quinquennial age groups.

In order to overcome some of these limitations, the birth rates estimated by the reverse survival method are obtained by assuming that there is no net migration at the state level. Also, the mortality level is obtained on the assumption of stable population. Since there is some evidence of decline in birth rates, it is likely that the actual mortality level is higher. This would imply a lower reverse survival factor and, therefore, lower birth rates. However, no firm conclusions can be drawn regarding changes in birth rates between 1961 and 1971 in view of the methodological limitations of the estimates.

B. ESTIMATE BY STABLE POPULATION MODEL: C (X) METHOD

The United Nations Manual IV[1] has outlined a method of estimating vital rates from the cumulative proportionate age distribution based on stable population model. The method of adjusting for quasi-stability is also indicated. From what has been stated about population growth since 1901, it does appear reasonable to assume quasi-stability. Fertility seems to have remained fairly stable but the same is not true of mortality and migration. There is some indication of a steady decline in mortality. However, the decade 1941-1950 decidedly made a break because of large-scale killing and exodus due to Partition. Although the population growth of most of the districts fluctuated to a certain extent, the over-all trend between 1901 and 1961 was one of acceleration in growth.

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[1] United Nations, Department of Economic and Social Affairs, *Methods of Estimating Basic Demographic Measures from Incomplete Data*, Manual IV, 1967.

Although applicability of stable population models to Punjab and its districts is somewhat doubtful because of the migration factor, calculations of the birth rate were made to obtain an idea of the range. The refinement of adjusting for quasi-stability was not attempted. For convenience of reference, the method is called the $C(x)$ method.

The female birth rate was estimated by the method, using cumulative proportion of women, $C(x)$ for $x = 5, 10..45$. The Manual recommends taking $C(x)$ from the unsmoothed data. This leads to wide fluctuations in the estimated birth rate for the different values of x. Accordingly, the smoothed age distribution prepared by the Census Actuary was used for the calculations. For the given growth rate ($r = 0.02626$), values of $C(x)$ for the different values of x were found to range between levels 9 and 11, except for $x = 40$ and 45, when the levels were 11 and 13 respectively. The estimated values of the birth rate varied between 44.8 and 47.6, the median value being 45.5. "Ideally each combination of r and $C(x)$ for a given sex should define the same stable population."[2]

The birth rate for both sexes combined is obtained by multiplying the female birth rate by the product of 2.05 and the proportion of females in the total population as of the 1961 Census, taking 1.05 as the sex ratio at birth. Thus, the birth rate for Punjab during 1951-1961 estimated by this method was found to be 43.2 and the death rate 17.4. Incidentally, these rates are slightly higher than those estimated by reverse survival method.

For the decade 1961-1971, applicability of the stable model posed further problems because the 1971 census age data are lumped together for the ages 0-14. Moreover, Punjab showed a net out-migration of 2.8 per cent during the intercensal decade. While migration of this magnitude is an important element to be reckoned with, its contribution to the growth of population at the state level is not so large as to cause serious distortion of the results obtained on the assumption of a closed population. However, they may be relied upon for giving only a broad dimensional view and not their precise measures.

Assuming the rate of population growth to be identical with the rate of natural increase and taking the given $C(x)$ values, the appropriate mortality level corresponding to the values of these parameters were interpolated from the data presented in the Regional Model Life Tables and Stable Populations.[3] Mortality level 14.2 corresponds closely to the values of 'r' and $C(x)$ for females in Punjab.[4] This yields e_0^0 of 53 years. The projected value given in the Report of the Expert Committee on the Population Projections, 1968, for the mid-point of the decade was also 53.

The next step was to estimate the number of female children 0-9 included in the age group 0-14. This was done by estimating the number in the ages 10-14. According to the 1961 Census, female children 10-14 comprised 12.4 per cent of the total female population in Punjab; the same proportion was assumed to hold good in 1971. This proportion was applied to the total population to obtain the number in age-group 10-14 which is deducted from the total number in age-group 0-14 to get the number 0-9. This number was projected backward by the reverse survival factor to give the number of births in 1961-1971. The number of births was then divided by the arithmetic mean of the female population in 1961 and 1971 to obtain the estimate of the female birth rate. The birth rate for the two sexes combined was subsequently obtained by the method outlined earlier.

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[2] *Ibid.*, p.63.

[3] Ansley J. Coale and Paul Demeny, *Regional Model Life Tables and Stable Population*, (Princeton, Princeton University Press, 1966).

[4] No attempt is made to estimate separately the mortality levels for the new states of Punjab and Haryana because there is a sizable interchange of population between the two states.

ANNEX II

METHODOLOGICAL NOTE ON AGRICULTURE DATA

1. Sources and limitations of data

Data on output, land area, pattern of land utilization and irrigation for Punjab were obtained from the Season and Crop Reports, Office of the Director of Land Records, Government of Punjab, for all districts except the PEPSU districts, i.e. Patiala, Bhatinda, Kapurthala, Sangrur and Mahendragarh, for the years 1951/52 to 1954/55. For the PEPSU districts, data on production were available from 1951/52 to 1954/55 from Estimates of Area and Yield of Principal Crops in India (vol. II) issued by the Directorate of Economics and Statistics, Ministry of Food and Agriculture, Government of India, while those on land utilization and irrigation were collected from the Indian Agricultural Statistics. Data on area and output of various crops in Orissa from 1952/53 to 1962/63 were readily obtained from the study of Giri and Hendrix (Growth of Crop Output in Orissa) and those on land utilization from the Indian Agricultural Statistics. Data for 1951/52 were from Estimates of Area and Yield of Principal Crops in India, vol. II.

There were a few anomalies in the data for Orissa due to defects and inadequacies in the collection and compilation of the data. Where data for a certain crop in a year were not recorded, the simple averages of figures in the preceding and the following year were used. Whenever exactly the same figures are reported for consecutive years, the veracity of the data is suspect. Also, many times sharp bumps in the data are observed. For example, the output of rice in Baudh Khondmals fell from 80,000 tons in 1959/60 to 45,000 tons in 1960/61, and then rose to 80,000 in the next year. Similarly, the output of pulses in Balasore increased from 1,702 tons in 1961/62 to 4,000 tons in 1962/63. Discrepancies were also noted in the trends in area and output of a few crops. For example, Baudh Khondmals experienced a decline of 60 per cent in area under rice from 1959/60 to 1960/61, while the fall in output was only about 40 per cent, thus implying a rise in productivity of about 50 per cent in a single year. Again, in 1961/62, while the output attained the level of 1959/60, the area declined by about one third. The process of aggregation tended to reduce the margin of such errors in the figures of total crop output and area. Moreover, the trends obtained from such data indicate only broad orders of magnitude.

A recent study of land utilization statistics in Orissa by Giri[1] revealed serious limitations in the data. He pointed out that figures of area under different land-use categories reported for 1950/51, 1955/56 and 1960/61 were almost invariably repeated for four subsequent years in all districts. The changes in the corresponding quinquennial figures were due partly to fuller accounting of cumulative changes over five years and partly to change in the method and extent of "reporting area" and concepts and definition.[2]

2. Measurement of agricultural output

Ordinarily, agriculture includes output of all the crops, including vegetables and fruits, as well as output of allied activities like poultry, dairy, fishery, forestry, etc. However, this study was confined to crop output, which, on the average, accounted for about four fifths of total agricultural production. The major part of the residual area was devoted to fodder. Output of the allied activities, comprising animal husbandry, forestry, fishery, etc. is likely to be significant in some districts, but it was omitted here because direct measures of output from these sources, especially at the district level, could not be obtained from the available sources.

3. Coverage of crops

Agricultural output covered 21 crops in Punjab, namely rice, wheat, jowar, bajra, barley, maize, gram, sugarcane, rapeseed and mustard, cotton (desi), cotton (American), ragi, small millets, potatoes, groundnut, sesamum, linseed, tobacco, chillies, other pulses and tea. In Orissa, the number of crops covered was 22, the additional crops being tur among pulses, castor among oilseeds, and jute and mesta among fibre crops, and the crops not included being barley and tea as their output is negligible in Orissa. Also, there is one variety of cotton, as opposed to two in Punjab. In Punjab, the crops covered accounted for 81 per cent of the gross sown area in the period 1951-1954 and 86 per cent in 1960-1963. A good part of the remaining area, about 13 per cent, was under fodder. The fodder can be meaningfully translated into value terms only to the extent that it is converted into dairy products, but such output data are not available. In Orissa, the area covered by the selected crops constituted 80 per cent and 82 per cent of the total cropped area in 1951-1954 and 1960-1963 respectively.

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[1] R. Giri, "Changes in land-use pattern in Orissa", *Indian Journal of Agricultural Economics*, July-Sept. 1969, pp. 51-62.

[2] In the course of conversations with officials of the Directorate of Agriculture, it was revealed that the land utilization statistics for recent years are still in the process of revision and must be used with caution.

4. Choice of prices

The next step in the measurement of agricultural output was to choose a set of price weights for the different crops in order to aggregate them to a single magnitude. The decision in this regard is dependent on the use to which the data is to be put. If the purpose is to measure changes in the real income of farmers, the prices at which the farmer sells his output would have to be deflated by the price index of the commodities which he purchases. To do this requires data on the marketed surplus, the seasonal and spatial variations in prices, the quantities sold in different markets and seasons as well as changes in the relative prices and quantities of the commodities purchased by the farmers. Since the data on all these variables are not available, the set of prices used was at the state level. A substantial part of the produce is often sold during the harvest season, but the proportion varies according to the holding capacity of the farmer. Thus, there is still a case for using the farm harvest prices. Unfortunately, the farm harvest prices were available for only 17 crops. The final choice, therefore, was wholesale prices, which were available for all crops.

The need for constant price weights to determine changes in real income and/or productivity raises the issue of the appropriate period of reference for the prices. Alternative computations were made on the basis of the base period prices, the final period prices and the geometric mean of the two sets of prices. To eliminate the distorting effect of fluctuations in annual prices, the average of three years was considered for each set, namely 1953, 1954, 1955 and 1960, 1961, 1962 of the base and the final periods respectively for Punjab. For Orissa, however, the base period prices are for 1952, 1953, 1954 and the final period prices are for 1959, 1960, 1961. The advantage of using the mean of the sets of prices[3] (close to the base and the final periods respectively) is that it tends to remove the upward and the downward biases likely to be introduced by the use of the base period and the final period prices respectively.

Anyway, the differences in the results obtained from different computations were relatively insignificant. Minhas and Vaidyanathan also noted that "experiments" with alternative sets of constant weights based on average prices prevailing in 1948-1951, 1956-1959 and 1960-1963 point to a remarkable stability in the numerical magnitudes of the overall growth rates[4]

5. Choice of the base period and the final period

In view of the fluctuations in agriculture caused by natural factors like monsoons and floods, the rate of increase in agricultural output is highly sensitive to the choice of the base and the final periods. To maintain comparability between the agricultural data for years as close as possible to those of the 1951 and 1961 censuses, which are the major sources of data on population and labour force, averages for three years each, corresponding to the base and the final periods, were taken to offset the effects of annual fluctuations in agriculture. The obvious choice of base years would have been either 1949/50, 1950/51 and 1951/52 or 1950/51, 1951/52 and 1952/53. However, there were extremely poor harvests in 1950/51 and 1951/52, and the inclusion of these years would have depressed significantly the base period values and given an inflated measure of agricultural growth during the decade. The base period was, therefore, shifted forward by one year, thus including the data for the triennium 1951/52 to 1953/54. There were two additional reasons for omitting the year 1950/51. One was that, for Punjab, shifting the base period forward further reduced the impact of the 1947 partition of the state. Secondly, the method of crop estimation was also changed around 1950/51from the "annawari" to that of yields from random crop-cutting surveys. The first method assumed a certain normal yield per acre for each district which was adjusted by a subjective "condition factor" (the ratio of actual yield to normal yield, which would be 16 annas if the two were equal) by the agency responsible for submitting the returns of output and acreage of different crops. The second method is based on crop-cutting experiments conducted in a random sample of the areas concerned. While the estimates thus obtained at the state level are reasonably accurate, those at the district level suffer from the limitations arising from the smallness of the sample. Thus, although absolute precision may not be claimed for any of the estimates at the district level, they may be used for drawing inferences of broad orders of magnitude.

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[3] R.G.D. Allen, *Statistics for Economists*, (London, 1966), p. 107.

[4] B.S. Minhas, and A. Vaidyanathan, "Growth of crop-output in India, 1951-54 to 1958-61", *Indian Society of Agricultural Statistics*, 1965.

The justifications for omitting 1950/51 can also be applied to 1951/52. However, also omitting the latter year would have shifted the base period too far away from the census year. On the other hand, an agriculturally bad year should probably be included in the base period. The monsoons do not and cannot be expected to remain normal over a number of years, and the selection for the base period of three years which were uniformly good would inflate the base period values. The three years chosen for the final period, viz. 1960/61, 1961/62 and 1962/63 steer clear of these difficulties. The final years 1968-1971 are regarded as normal for agricultural production.

6. Method of computing growth rates

Considering the annual fluctuations in agricultural output, it is not possible to claim absolute precision for the growth rate obtained by any of the techniques used for this purpose. The Ministry of Food and Agriculture measured the growth rates in various states for the period 1949/50 to 1964/65 by fitting the linear function of the form $Y = a + bt$ where 'Y' is the index of output, 't' is time, 'a' is a constant and 'b' is the growth rate over the time period under consideration. The Ministry has also worked out compound growth rates obtained from the exponential function of the form $Y = A(1+r)^t$ where A is a constant and r is the annual compound rate of growth. Both these methods, however, may give unreliable measures if there are haphazard fluctuations in output from year to year, so that the values of the regression coefficient 'b' in the linear form and 'r' in the log linear form turn out to be statistically insignificant. Also, they are likely to be biased by any episodic changes in any of the years considered. Again, data on most of the inputs, such as agricultural labour force, livestock and implements, to which changes in output are to be related, are available at decennial or quinquennial intervals, so that the changes in these variables can be estimated on the basis of the initial and the terminal values only. In this study, therefore, the simpler method of calculating the annual compound rates of growth from the initial and the final year values of output is used. The equation $P_t = P_O(1 + r)^t$, where P_O and P_t are the values of agricultural output for the base period and the final period respectively and 'r' is the annual compound rate of growth, is used for the purpose.

ANNEX III

CROP-WISE ANNUAL (COMPOUND) GROWTH RATES

In this annex, the annual compound growth rates of output, area and productivity for 16 crops (both foodgrains and non-foodgrains) are given for the districts of Punjab during the 1950s and 1960s in table 1. Similarly, in table 2 these rates are given for the districts of Orissa.

Table 1A. Cropwise annual (compound) growth rates in the districts of Punjab from 1951-1954 to 1960-1963

District	Rice			Wheat			Barley		
	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity
Hissar	19.9	15.4	3.9	16.4	12.9	3.1	1.4	-2.8	4.3
Rohtak	13.1	7.9	4.8	6.3	4.5	1.6	-2.1	-1.2	-1.2
Gurgaon	—	—	—	6.6	5.7	0.9	-5.5	-4.3	-1.3
Karnal	15.3	11.6	3.3	7.4	6.2	1.3	4.4	6.3	-1.8
Ambala	12.3	4.4	7.2	1.8	1.1	0.3	-1.4	-3.3	1.6
Hoshiarpur	10.0	8.1	1.7	1.2	-0.6	1.7	—	—	—
Jullundur	24.5	20.6	3.2	3.0	1.8	1.3	-8.0	-6.6	-1.6
Ludhiana	19.2	12.4	6.0	5.0	2.2	2.7	-0.3	-2.2	2.0
Ferozepur	7.1	2.9	4.1	4.1	3.8	0.3	-4.2	-4.4	0.2
Amritsar	5.4	6.4	-1.3	2.5	1.1	1.4	0.2	0.3	-0.1
Gurdaspur	6.8	4.5	2.3	0.9	1.2	-0.4	0.7	0.1	0.7
Bhatinda	26.4	22.4	3.3	6.6	4.2	2.2	-4.1	-10.3	6.9
Kapurthala	20.3	12.9	6.7	-3.0	2.8	-5.5	0.2	-1.7	2.0
Mahendragarh	—	—	—	6.0	9.5	-3.5	-4.8	-1.7	-3.1
Patiala	26.4	14.1	10.8	11.9	8.3	3.3	10.7	3.5	7.0
Sangrur	21.0	14.1	6.0	7.4	5.1	2.2	-0.7	-5.9	2.4
PUNJAB	9.7	6.9	2.6	5.1	3.6	1.5	-2.6	-3.3	0.8

District	JOWAR			BAJRA			MAIZE		
	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity
Hissar	-1.6	2.6	-4.2	-3.5	-4.9	1.5	25.4	24.2	0.9
Rohtak	-6.3	0.5	-6.8	-7.1	-3.3	-3.9	6.8	7.5	-0.7
Gurgaon	-4.1	0.9	-5.0	-1.6	-1.0	-0.7	6.0	4.3	1.6
Karnal	-6.3	-1.6	-4.9	-7.0	-3.3	-3.7	4.7	14.3	-8.5
Ambala	-11.6	-7.5	-4.7	-11.5	-8.0	-4.2	9.2	6.3	2.4
Hoshiarpur	-7.4	-1.2	-6.2	-8.8	-11.4	2.9	5.2	1.6	3.5
Jullundur	—	—	—	-25.4	-15.1	-12.2	-0.6	3.7	-4.2
Ludhiana	-11.5	-13.0	1.7	-21.3	-12.4	-10.2	3.9	4.5	-0.7
Ferozepur	-18.7	-7.0	-12.5	-6.7	-6.7	-0.4	3.4	9.1	-5.4
Amritsar	—	—	—	0.1	-7.0	7.5	-1.2	3.4	-4.5
Gurdaspur	—	—	—	-1.6	-4.5	3.1	-2.7	-0.7	-2.0
Bhatinda	-9.9	-11.5	1.7	-4.7	-1.9	-2.9	13.5	15.7	-1.9
Kapurthala	—	—	—	-25.0	-12.6	-14.3	-1.3	3.7	-4.9
Mahendragarh	-0.8	-0.1	-0.7	3.9	-0.6	4.6	—	—	—
Patiala	-12.3	-8.7	-4.0	18.3	0.0	18.3	2.1	3.9	-1.8
Sangrur	0.3	1.5	-1.2	-3.4	-2.9	-0.5	1.0	4.7	-3.6
PUNJAB	-4.2	0.5	-4.9	-3.2	-3.2	0.0	2.8	3.9	-1.1

(Cont'd)

Table 1A (Cont'd)

District	GRAM			PULSES			POTATOES		
	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity
Hissar	14.9	16.2	-1.6	6.6	9.0	-2.2	8.6	4.7	3.6
Rohtak	3.6	5.1	-1.3	-5.9	-4.0	-1.7	3.2	2.1	1.0
Gurgaon	18.0	16.7	0.9	0.4	-2.2	2.3	9.4	4.7	4.4
Karnal	7.6	5.3	2.1	5.5	5.2	0.1	3.9	3.9	0.1
Ambala	4.4	4.7	-0.5	7.4	4.2	3.4	7.9	4.4	2.9
Hoshiarpur	1.3	2.8	-1.4	-2.5	-1.1	-1.1	37.4	31.4	4.6
Jullundur	4.1	4.0	0.3	0.3	0.3	-0.1	18.5	14.2	3.8
Ludhiana	2.7	-0.9	3.5	-7.8	-6.6	-0.9	21.3	15.9	4.7
Ferozepur	-1.4	-2.5	0.9	-15.3	-9.6	-5.4	10.0	6.7	3.1
Amritsar	-0.8	-1.6	0.9	4.1	4.3	-0.4	3.8	4.9	-1.3
Gurdaspur	2.3	1.9	0.2	-4.5	-1.1	-3.3	-5.3	-9.5	4.5
Bhatinda	3.1	3.5	-0.6	-1.2	-1.3	-0.1	13.6	-1.5	15.3
Kapurthala	1.4	6.8	-5.2	-2.5	4.2	-6.8	9.9	4.5	5.2
Mahendragarh	28.1	19.5	8.6	27.6	9.7	17.9	—	—	—
Patiala	11.6	10.4	0.9	7.3	2.8	4.3	19.5	-0.3	19.9
Sangrur	2.3	2.4	0.1	0.8	2.1	-1.2	16.3	3.8	12.0
PUNJAB	5.6	6.3	-0.4	1.6	2.6	-1.3	12.6	7.8	4.3

District	SUGARCANE			OILSEEDS			COTTON (DESI)		
	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity
Hissar	13.6	13.0	0.7	23.6	11.0	12.8	16.5	13.0	3.2
Rohtak	8.3	7.0	1.3	3.2	0.7	2.5	3.0	0.8	2.1
Gurgaon	12.4	11.5	0.8	9.3	1.0	8.5	-11.0	-12.1	1.4
Karnal	10.7	12.6	-1.7	3.3	-2.6	5.8	-4.6	-4.4	-0.2
Ambala	5.9	4.2	1.3	-1.4	-6.4	4.8	-1.6	-2.2	0.2
Hoshiarpur	3.5	1.1	2.3	4.0	1.2	2.7	-4.5	-4.8	0.2
Jullundur	4.6	1.9	2.9	9.9	8.6	1.3	2.5	2.7	-0.2
Ludhiana	2.4	0.5	1.9	2.7	1.2	1.8	8.8	6.0	2.7
Ferozepur	3.7	2.9	0.7	2.6	-1.3	3.8	13.0	9.9	2.8
Amritsar	-0.7	-2.3	1.6	-0.5	-5.8	5.4	0.6	1.3	-0.7
Gurdaspur	5.5	1.2	4.2	-1.4	-5.5	4.3	0.5	-0.9	1.5
Bhatinda	3.6	1.5	2.1	10.8	3.8	6.7	8.1	5.4	2.5
Kapurthala	0.7	2.7	-1.9	-7.7	-7.7	0.1	6.8	1.5	5.2
Mahendragarh	—	—	—	—	—	—	—	—	—
Patiala	9.2	9.1	0.1	18.6	8.0	10.8	4.7	2.3	2.2
Sangrur	9.6	4.9	4.4	4.9	1.7	3.1	6.2	3.7	2.3
PUNJAB	6.7	4.9	1.6	8.7	2.8	5.7	9.7	4.4	5.0

(Cont'd)

Table 1A (Cont'd)

District	COTTON (AMERICAN)			TOBACCO			CHILLIES		
	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity
Hissar	7.2	6.1	1.0	-3.1	-6.1	3.2	-7.6	9.3	-3.3
Rohtak	13:4	16.0	-2.2	-6.0	-8.3	2.3	-1.9	-4.0	2.2
Gurgaon	—	—	—	-1.2	-6.8	6.0	8.0	3.2	4.6
Karnal	8.3	9.5	-1.2	-4.4	-7.3	3.1	2.1	-2.9	5.2
Ambala	62.5	34.3	20.6	-6.9	-5.4	-0.8	1.4	0.4	0.7
Hoshiarpur	—	—	—	1.8	-3.0	4.3	—	—	—
Jullundur	9.1	10.6	-1.4	-11.5	-8.7	-3.2	8.3	6.7	1.5
Ludhiana	7.7	9.2	-1.4	—	—	—	-4.4	-8.7	4.7
Ferozepur	6.1	4.8	1.3	—	—	—	-1.7	-2.1	0.3
Amritsar	2.3	5.1	-2.7	—	—	—	11.0	11.0	—
Gurdaspur	2.1	6.4	-4.0	—	—	—	—	—	—
Bhatinda	14.6	13.8	0.7	—	—	—	2.3	0.6	1.7
Kapurthala	—	—	—	—	—	—	10.7	11.7	-0.9
Mahendragarh	—	—	—	1.3	-14.1	15.4	—	—	—
Patiala	19.9	23.0	-2.5	—	—	—	8.2	4.6	3.5
Sangrur	10.7	10.3	0.4	—	—	—	1.9	-13.6	18.0
PUNJAB	8.4	7.9	0.6	-3.1	-6.3	3.3	3.8	1.4	2.3

District	TEA			FOODGRAINS			NON-FOODGRAINS		
	Out put	Area	Productivity	Out-put	Area	Productivity	Out-put	Area	Productivity
Hissar	–	–	–	9.8	5.2	4.4	14.9	10.4	4.7
Rohtak	–	–	–	3.1	1.8	1.2	7.3	5.0	2.9
Gurgaon	–	–	–	4.1	2.9	1.2	9.9	2.2	7.7
Karnal	–	–	–	7.4	5.5	2.0	7.9	3.6	4.4
Ambala	–	–	–	4.6	2.3	2.3	4.6	0.1	4.3
Hoshiarpur	–	–	–	4.0	1.0	3.0	2.9	-0.1	3.0
Jullundur	–	–	–	3.8	2.7	1.1	5.2	4.2	1.0
Ludhiana	–	–	–	4.4	1.6	2.8	4.1	3.1	1.0
Ferozepur	–	–	–	2.1	0.7	1.5	6.4	4.8	1.6
Amritsar	–	–	–	2.1	1.4	0.7	1.1	-0.6	1.7
Gurdaspur	–	–	–	1.6	1.4	0.1	4.2	-1.4	5.8
Bhatinda	–	–	–	3.5	1.7	1.7	10.3	6.8	3.5
Kapurthala	–	–	–	-0.1	3.8	-3.9	3.5	5.7	-2.2
Mahendragarh	–	–	–	—	—	—	—	—	—
Patiala	–	–	–	11.9	8.8	3.0	11.3	8.8	2.6
Sangrur	–	–	–	4.5	2.6	1.8	7.0	2.9	4.0
PUNJAB	4.4	-0.1	4.5	4.6	2.9	1.7	7.5	4.5	3.0

Table 1B. Cropwise annual (compound) growth rates in the districts of Punjab from 1960-1963 to 1968-1971

District	RICE			WHEAT			JOWAR		
	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity
Hissar	-1.9	-1.7	-0.2	8.8	4.6	4.0	-6.8	-8.8	2.1
Rohtak	13.1	14.7	-1.3	9.6	5.2	4.2	2.9	-2.4	5.5
Gurgaon	—	—	—	12.6	7.4	4.9	-2.6	-4.3	1.8
Karnal	7.4	6.6	0.8	15.3	7.4	7.3	-7.2	-8.0	0.8
Ambala	-1.6	1.9	-3.4	6.2	4.1	2.0	-17.3	-7.8	-10.3
Hoshiarpur	5.0	4.0	1.0	12.4	6.0	6.0	-8.9	-17.7	10.8
Jullundur	5.9	4.7	1.2	13.1	4.8	7.9	—	—	—
Ludhiana	13.6	11.1	2.2	18.3	9.3	8.3	21.2	17.3	3.3
Ferozepur	6.1	6.8	-0.8	11.3	3.8	7.3	12.9	-5.0	18.9
Amritsar	10.3	5.9	4.1	15.6	5.4	9.7	—	—	—
Gurdaspur	7.4	6.2	1.1	13.5	3.1	10.1	-12.9	-23.6	13.9
Bhatinda	—	—	—	13.6	7.2	6.0	10.4	-5.2	16.5
Kapurthala	8.9	6.9	1.8	16.5	3.3	12.8	—	—	—
Mahendragarh	—	—	—	17.1	11.9	4.7	-6.7	-7.4	0.8
Patiala	8.3	7.4	0.9	10.9	3.9	6.7	18.7	7.4	10.5
Sangrur	4.7	6.7	-1.9	11.8	5.3	6.2	1.4	-3.8	5.4
PUNJAB	5.7	5.0	0.6	12.0	5.1	7.0	-1.5	-5.1	3.8

District	BAJRA			BARLEY			MAIZE		
	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity
Hissar	12.7	3.8	8.5	22.3	-0.3	22.7	0.2	-1.6	1.8
Rohtak	13.0	0.3	12.6	8.9	4.0	4.7	0.1	3.4	-3.2
Gurgaon	9.6	0.1	9.6	9.3	4.1	5.0	8.6	13.8	-4.6
Karnal	8.2	1.4	6.7	12.6	5.6	6.6	4.0	-0.7	4.7
Ambala	19.5	3.0	16.0	0.5	-1.9	2.7	3.5	1.3	2.1
Hoshiarpur	-2.8	0.1	-2.8	—	—	—	5.0	4.2	0.8
Jullundur	9.0	-11.4	23.0	-1.2	5.6	-6.4	8.0	6.4	1.5
Ludhiana	29.9	10.0	18.1	3.3	0.3	2.9	12.9	8.6	3.9
Ferozepur	14.3	7.9	5.9	3.0	5.9	-2.7	13.1	9.0	3.8
Amritsar	0.4	1.2	-0.8	-4.3	-3.4	-0.9	7.5	2.1	5.3
Gurdaspur	-1.4	-3.9	2.6	-3.4	-0.7	-2.8	-0.6	6.7	-6.9
Bhatinda	19.0	6.0	12.3	-1.4	-2.8	1.5	18.7	11.0	7.0
Kapurthala	33.4	19.7	11.4	-2.2	-2.9	0.7	9.9	4.1	5.7
Mahendragarh	3.6	1.0	2.5	7.4	0.1	7.3	—	—	—
Patiala	35.6	18.3	14.6	-3.1	-5.9	3.1	6.0	0.9	5.1
Sangrur	13.0	3.3	9.4	3.6	1.8	1.8	12.5	6.0	6.2
PUNJAB	11.4	2.5	8.6	8.7	2.0	6.5	7.1	3.8	3.3

(Cont'd)

Table 1B (Cont'd)

District	GRAM			SUGARCANE			COTTON (DESI)		
	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity
Hissar	-5.4	-6.6	1.4	16.1	8.5	7.0	10.1	16.2	-5.3
Rohtak	-0.1	-5.0	5.2	1.5	0.8	0.7	-0.1	7.1	-6.7
Gurgaon	-0.3	-5.0	4.9	4.8	1.8	3.0	-5.6	-0.3	-5.3
Karnal	-7.7	-9.4	1.9	5.4	3.2	2.1	14.5	11.3	2.9
Ambala	-3.7	-3.5	-0.3	4.1	8.7	-4.3	-6.2	3.2	-9.2
Hoshiarpur	-8.2	-7.9	-0.3	-1.3	-2.4	1.2	-5.2	-6.2	1.1
Jullundur	-17.8	-20.9	3.9	-0.3	-0.4	0.1	-3.5	-2.0	-1.5
Ludhiana	-22.3	-22.8	0.7	1.7	1.1	0.6	-3.7	-3.1	-0.6
Ferozepur	-10.4	-9.7	-0.8	8.7	7.6	1.0	-1.9	-3.7	1.9
Amritsar	-11.5	-12.4	1.0	5.8	2.8	3.0	-6.4	-10.2	4.2
Gurdaspur	-14.0	-11.7	-2.7	5.5	4.7	0.8	-2.9	-3.0	0.1
Bhatinda	-5.1	-6.9	1.9	20.5	17.7	2.4	1.5	-1.3	2.8
Kapurthala	-22.3	-22.8	0.6	-4.3	-5.4	1.1	-2.8	-5.5	2.9
Mahendragarh	3.9	-0.1	4.1	75.1	69.6	3.3	—	—	—
Patiala	-10.5	-12.4	2.1	3.6	-1.0	4.6	-3.0	-2.7	-0.2
Sangrur	-5.7	-9.1	3.7	0.3	-0.2	0.5	-10.8	-6.2	-4.9
PUNJAB	-5.4	-7.2	1.9	4.2	3.2	1.0	-1.0	0.2	-1.2

District	COTTON (AMERICAN)			POTATOES			GROUNDNUTS		
	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity
Hissar	16.9	21.3	-3.6	7.4	7.9	-0.5	—	—	—
Rohtak	-18.5	-10.0	-10.0	11.3	16.4	-4.4	—	—	—
Gurgaon	-4.3	2.8	-6.9	5.4	5.3	0.1	—	—	—
Karnal	-9.9	-0.2	-9.7	6.6	6.4	0.3	—	—	—
Ambala	-4.2	-17.6	16.3	7.6	6.4	1.1	13.1	14.7	-1.3
Hoshiarpur	-12.1	-7.8	-4.7	8.8	16.1	-6.3	43.7	44.7	-0.7
Jullundur	-17.2	-18.0	1.0	6.0	7.5	-1.5	19.3	15.6	3.2
Ludhiana	-5.3	-7.4	2.3	7.8	11.6	-3.4	10.9	11.3	-0.3
Ferozepur	-3.7	0.8	2.8	-2.5	2.1	-4.6	37.5	46.2	-5.9
Amritsar	2.5	-1.8	4.3	2.6	0.9	1.6	—	—	—
Gurdaspur	-11.2	-11.1	-0.1	17.8	26.2	-6.7	—	—	—
Bhatinda	7.8	3.8	3.9	9.4	13.9	-4.0	37.7	38.9	-0.9
Kapurthala	-13.6	-15.0	1.6	2.6	7.0	-4.1	23.0	20.7	1.9
Mahendragarh	—	—	—	—	—	—	—	—	—
Patiala	-0.7	-4.2	3.7	-2.8	-0.1	-2.7	8.3	7.9	0.3
Sangrur	-16.3	-9.0	-8.0	-8.8	0.9	-9.6	14.5	13.5	0.8
PUNJAB	39.0	7.8	29.0	4.6	6.5	-1.9	13.6	13.0	0.5

(Cont'd)

Table 1B (Cont'd)

District	TOBACCO			CHILLIES			OTHER PULSES		
	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity
Hissar	11.9	10.1	1.6	-9.5	-5.7	-4.1	4.7	2.1	2.6
Rohtak	1.3	14.5	-11.5	-25.6	-9.7	-17.7	5.0	23.8	-15.2
Gurgaon	-5.1	-12.8	8.8	7.0	7.3	-0.3	2.6	7.1	-4.2
Karnal	-3.7	-1.5	-2.2	-11.7	-4.7	-7.4	-6.1	-2.7	-3.6
Ambala	8.8	-8.1	18.4	-10.5	-6.5	-4.3	-6.2	-2.8	-3.6
Hoshiarpur	-12.2	-12.6	0.5	—	—	—	-3.4	-2.3	-1.1
Jullundur	-6.2	-12.8	7.6	-6.8	-8.7	2.1	-4.4	-4.3	-0.2
Ludhiana	—	—	—	1.7	-0.1	1.8	14.9	9.4	5.0
Ferozepur	-24.3	-10.5	-15.4	-10.7	-3.8	-7.2	-0.1	-0.8	0.8
Amritsar	—	—	—	-8.6	-10.4	2.1	-8.6	-6.7	-2.1
Gurdaspur	—	—	—	—	—	—	-1.4	-0.4	- 1.0
Bhatinda	—	—	—	-2.7	-5.0	2.4	2.0	0.6	1.4
Kapurthala	—	—	—	-13.6	-16.7	3.8	-13.8	-11.2	-2.9
Mahendragarh	14.5	-14.7	34.3	—	—	—	5.0	4.2	0.8
Patiala	—	—	—	-6.2	-7.5	1.3	-7.9	-4.7	-3.3
Sangrur	-8.0	-12.4	5.0	-4.3	-1.4	-3.0	-1.5	0.5	-2.0
PUNJAB	0.7	-3.6	3.0	-7.8	-6.5	-1.4	-1.8	1.7	-3.5

Districts	OILSEEDS (EXCLUDING GROUNDNUT)			FOOD CROPS			NON-FOOD CROPS		
	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity
Hissar	-8.7	-10.0	1.4	2.7	-1.8	4.6	6.6	7.2	-0.5
Rohtak	-5.8	-4.0	-1.8	7.0	0.3	6.8	-0.3	-0.2	-0.1
Gurgaon	-7.9	-7.6	-0.4	8.2	0.5	7.7	2.1	-4.7	2.8
Karnal	4.4	0.4	4.0	8.5	1.7	6.7	4.1	2.5	1.5
Ambala	-2.5	3.0	-5.4	2.8	1.1	1.6	4.1	6.3	-2.1
Hoshiarpur	4.4	6.6	-2.1	7.4	3.2	4.1	-0.1	1.0	-1.0
Jullundur	13.5	10.7	2.5	9.8	3.1	6.5	1.2	3.1	-1.9
Ludhiana	5.8	2.8	2.8	14.8	6.0	8.3	3.4	4.7	-1.3
Ferozepur	-0.9	-2.6	1.8	7.9	1.9	6.0	2.7	-0.2	2.9
Amritsar	5.8	5.3	0.4	11.6	3.0	8.3	2.5	-1.1	3.6
Gurdaspur	8.4	4.2	4.0	9.5	3.0	6.3	5.4	3.1	2.2
Bhatinda	-5.8	-5.2	-0.7	9.5	1.5	7.9	5.0	0.8	4.2
Kapurthala	12.3	16.1	-3.2	12.4	2.8	9.3	1.9	5.7	-3.5
Mahendragarh	-9.9	-18.4	10.4	5.3	0.6	4.7	-3.6	-14.4	12.6
Patiala	-12.4	-10.2	-2.5	7.7	1.0	6.6	0.1	-1.1	1.2
Sangrur	-8.9	-11.8	3.3	9.5	2.2	7.2	-1.3	-0.6	-0.8
PUNJAB	-4.5	-5.3	6.0	7.7	1.0	6.6	4.7	2.3	0.8

Table 2A. Cropwise annual (compound) growth rates in the districts of Orissa from 1951-1954 to 1960-1963

District	RICE			JOWAR			BAJRA		
	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity
Sambalpur	4.4	0.4	4.0	-12.4	-2.8	-9.9	-19.4	-16.4	-3.7
Sundergarh	2.8	1.5	1.3	0.2	0.0	0.2	- 8.8	- 1.8	-7.1
Keonjhar	4.7	-1.6	6.5	-10.5	-8.6	-2.1	31.1	22.7	3.0
Mayurbhanj	3.6	-1.2	4.9	—	—	—	—	—	—
Balasore	4.4	-0.4	4.9	0.0	0.0	0.0	0.0	0.0	0.0
Cuttack	5.8	-0.6	6.3	0.0	0.0	0.0	0.3	- 0.3	0.6
Dhenkanal	11.1	3.0	7.9	-18.8	-16.4	2.9	—	—	—
Baudh-Khondmals	-2.1	-3.5	1.0	- 0.0	0.0	0.0	0.0	0.0	0.0
Bolangir	7.4	2.1	5.2	3.6	3.6	0.0	- 3.6	- 0.3	-3.2
Kalahandi	9.2	4.0	5.0	7.4	2.2	5.4	3.8	5.6	-1.7
Koraput	5.0	2.9	2.0	5.3	1.0	4.3	3.7	0.0	3.7
Ganjam	11.7	2.2	9.3	12.3	0.8	11.5	0.0	0.0	0.0
Puri	6.1	0.0	6.1	1.7	13.9	-10.7	1.7	0.0	0.0
ORISSA	5.7	0.7	5.0	5.8	0.6	5.2	0.0	1.3	-1.3

District	MAIZE			RAGI			WHEAT		
	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity
Sambalpur	0.3	2.8	- 2.4	8.0	5.8	2.0	20.4	19.8	0.5
Sundergarh	3.1	-1.0	4.1	1.8	-0.3	2.1	6.1	0.2	5.9
Keonjhar	5.1	6.9	-1.4	-22.3	-13.3	-10.4	1.4	1.9	-0.4
Mayurbhanj	4.7	1.8	2.8	- 1.3	4.3	- 5.3	8.9	6.9	1.9
Balasore	-6.7	-7.7	1.1	0.0	0.0	0.0	0.0	13.7	0.0
Cuttack	-1.6	-0.8	- 0.8	- 8.0	- 6.8	- 1.2	1.2	-0.7	0.5
Dhenkanal	13.2	-2.6	16.2	6.6	- 1.2	7.8	0.2	8.2	-7.4
Baudh-Khondmals	-5.2	-1.0	- 4.3	- 9.3	- 4.3	-5.2	-8.1	-4.9	-3.3
Bolangir	3.2	1.8	1.3	0.4	- 0.1	0.5	5.3	6.5	-1.1
Kalahandi	15.5	11.2	3.9	6.2	2.2	4.0	5.4	0.3	5.1
Koraput	5.4	1.6	3.8	-20.0	-18.0	- 2.4	4.1	19.4	-12.8
Ganjam	-7.7	-11.4	4.2	8.5	6.2	2.1	0.0	0.0	0.0
Puri	0.0	0.4	-0.4	5.3	2.3	3.0	-4.3	-1.3	-3.0
ORISSA	4.3	1.8	2.5	- 5.7	- 6.3	0.7	3.2	6.0	-2.6

District	SMALL MILLETS			PULSES			OILSEEDS		
	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity
Sambalpur	8.3	-1.8	10.3	3.0	8.0	-4.7	3.6	-2.0	5.8
Sundergarh	0.0	0.0	0.0	9.7	0.9	8.7	1.4	-0.3	1.7
Keonjhar	-100.0	100.0	100.0	-6.0	8.3	-13.2	-8.2	-6.5	-1.7
Mayurbhanj	2.9	-0.3	3.2	2.1	10.3	-7.4	9.9	3.7	6.0
Balasore	0.0	-100.0	0.0	-2.0	-11.1	-0.9	-14.0	-9.2	-5.3
Cuttack	-4.0	-0.3	-3.7	5.3	5.4	-0.1	2.4	0.3	2.1
Dhenkanal	35.1	29.4	4.4	-8.1	0.3	-8.3	-5.2	-4.5	-0.8
Baudh-Khondmals	-1.3	-6.7	5.7	0.2	-3.3	3.7	-17.0	-9.9	-8.0
Bolangir	9.0	-0.1	9.1	11.3	8.0	3.1	3.4	-1.2	4.7
Kalahandi	0.0	0.0	0.0	12.0	4.0	7.7	13.4	6.7	6.3
Koraput	12.7	5.2	7.1	-9.5	-0.1	-9.4	6.4	2.3	4.1
Ganjam	-11.0	-11.3	0.3	-5.8	-3.3	-2.6	2.9	-2.0	5.1
Puri	2.5	2.9	-0.4	1.2	4.6	-3.2	-1.9	0.4	2.3
ORISSA	7.3	-1.5	8.9	3.6	5.2	-1.5	2.2	-0.3	2.5

(Cont'd)

Table 2A (Cont'd)

District	FIBRE CROPS			POTATOES			CHILLIES		
	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity
Sambalpur	8.7	7.4	1.2	14.6	15.4	-0.7	19.1	7.0	11.3
Sundergarh	0.6	0.6	-0.1	20.4	17.4	2.6	18.6	9.3	8.5
Keonjhar	-7.3	-9.3	2.2	-4.9	1.0	-5.9	-0.3	-12.5	14.0
Mayurbhanj	2.4	1.2	1.2	-6.4	10.3	-15.1	3.8	3.0	0.7
Balasore	-4.8	-6.1	1.3	0.0	20.6	0.0	0.7	2.4	-1.7
Cuttack	2.6	1.2	1.4	3.9	2.9	0.9	-21.6	-7.5	-15.3
Dhenkanal	16.4	-3.9	21.1	13.5	14.3	-0.7	-8.6	5.8	-13.6
Baudh-Khondmals	5.7	-0.2	5.9	-0.3	8.7	-8.4	7.6	1.3	6.2
Bolangir	3.8	2.5	1.2	13.7	12.3	1.2	9.4	2.3	7.0
Kalahandi	0.7	-1.7	2.4	35.7	21.3	11.9	3.2	-4.2	7.7
Koraput	7.1	2.6	4.4	8.5	2.2	6.2	2.4	-3.0	5.6
Ganjam	2.6	2.4	0.2	7.3	10.0	-2.5	2.1	-2.1	4.3
Puri	20.7	14.3	5.5	3.4	4.1	-0.7	-8.5	-1.2	-7.4
ORISSA	1.6	-0.2	1.8	7.3	5.8	1.4	-5.8	-2.6	-3.3

District	TOBACCO			SUGARCANE			FOOD CROPS		
	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity
Sambalpur	-8.9	0.4	-9.2	-1.8	1.8	-3.5	4.4	1.0	3.4
Sundergarh	-4.8	-1.7	-3.1	-0.5	1.0	-0.5	4.2	1.4	2.8
Keonjhar	-16.0	-0.0	-16.0	-1.3	2.3	-3.5	4.5	-1.2	5.8
Mayurbhanj	-8.9	2.8	-11.4	-9.2	0.3	-9.0	3.6	-1.0	4.7
Balasore	0.0	-16.4	0.0	10.5	1.1	9.2	4.4	-0.5	4.8
Cuttack	4.3	1.1	3.2	0.7	-1.7	2.5	5.5	0.3	5.3
Dhenkanal	6.7	3.2	3.3	-7.7	-0.1	-7.6	9.4	2.7	6.6
Baudh-Khondmals	-17.7	-20.7	3.7	-5.5	9.7	-13.8	-2.1	-3.6	1.5
Bolangir	0.3	4.2	-3.7	6.2	3.4	2.7	8.1	2.9	5.0
Kalahandi	-4.0	-8.0	3.2	10.6	7.1	3.3	9.9	4.0	5.7
Koraput	23.4	13.3	8.9	-3.4	1.1	-4.4	2.7	0.8	1.9
Ganjam	11.2	1.3	9.8	2.9	-4.1	7.4	9.4	1.7	7.5
Puri	-5.3	2.0	-7.1	0.9	-0.0	1.0	5.1	1.1	3.9
ORISSA	7.3	3.7	3.5	0.1	1.2	-1.1	5.3	1.1	4.2

District	NON-FOOD CROPS			ALL CROPS		
	Output	Area	Productivity	Output	Area	Productivity
Sambalpur	1.5	-0.5	1.9	4.1	0.9	3.2
Sundergarh	1.0	-0.0	1.0	4.0	1.3	2.6
Keonjhar	-6.5	-7.0	0.5	3.6	-1.5	5.1
Mayurbhanj	-0.5	2.5	-2.9	3.5	-0.9	4.5
Balasore	-3.1	-5.6	2.7	3.9	-0.5	4.5
Cuttack	1.2	0.3	0.9	4.7	0.2	4.4
Dhenkanal	-4.6	-3.9	-0.7	7.7	2.0	5.6
Baudh-Khondmal	-15.2	-8.8	-7.0	-3.4	-4.1	0.7
Bolangir	4.4	-0.7	5.2	7.6	2.5	5.0
Kalahandi	9.6	6.2	3.3	9.9	4.2	5.4
Koraput	6.4	2.6	3.7	3.3	0.9	2.3
Ganjam	3.6	-1.7	5.4	8.9	1.5	7.3
Puri	1.9	1.6	0.3	4.9	1.1	3.8
ORISSA	1.7	-0.2	1.9	4.9	1.0	3.9

Table 2B. Cropwise annual (compound) growth rates in the districts of Orissa from 1960-1963 to 1968-1971

District	RICE			JOWAR			BAJRA		
	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity
Sambalpur	3.3	1.6	1.7	28.7	2.9	25.1	37.3	17.5	16.8
Sundargarh	-2.2	-1.6	-0.6	24.5	20.5	3.3	-13.8	-16.1	2.8
Keonjhar	-0.7	-0.3	-0.3	60.8	40.9	14.2	15.1	-2.2	18.9
Mayurbhanj	1.1	0.2	0.9	—	—	—	—	—	—
Balasore	3.3	1.0	2.3	—	—	—	—	—	—
Cuttack	5.0	2.8	2.1	—	—	—	-10.4	-12.1	2.0
Dhenkanal	1.3	0.8	0.5	61.5	32.5	21.9	-4.3	5.0	-8.9
Bandh-Khondmals	5.6	-1.1	6.8	100.6	68.3	19.2	—	—	—
Bolangir	2.9	1.7	1.2	-8.6	-27.1	-25.5	—	—	—
Kalahandi	-0.6	0.3	-0.9	-4.9	-10.9	6.7	-3.0	-6.3	3.4
Koraput	-2.3	-1.4	-0.9	11.3	14.7	-3.0	-5.6	-6.0	0.4
Ganjam	2.0	3.4	-1.3	17.4	19.1	-1.4	—	—	—
Puri	1.1	0.8	8.2	1.5	-11.3	14.4	-21.7	-20.9	-1.0
ORISSA	1.8	1.0	0.8	10.3	10.4	-0.1	-4.7	-7.6	3.1

District	MAIZE			RAGI			WHEAT		
	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity
Sambalpur	11.7	-1.6	13.5	12.7	5.4	6.9	32.8	12.4	18.1
Sundargarh	4.6	2.8	1.7	15.7	24.4	-7.1	31.7	30.7	9.1
Keonjhar	27.4	12.4	13.3	57.0	28.9	21.8	28.7	17.0	10.0
Mayurbhanj	29.7	18.1	9.8	25.7	13.8	10.4	31.1	15.8	13.3
Balasore	51.2	42.7	5.9	—	—	—	37.2	24.9	9.8
Cuttack	4.2	-0.1	4.2	15.4	10.0	4.9	6.0	2.0	3.9
Dhenkanal	6.8	8.3	-1.4	21.4	9.2	11.1	36.7	13.0	21.0
Baudh-Khondmals	42.3	13.4	25.5	39.9	20.5	16.0	21.3	3.4	17.3
Bolangir	17.6	16.7	0.8	4.5	3.6	0.9	8.6	2.4	6.0
Kalahandi	12.1	7.7	4.1	0.1	-5.0	5.4	7.7	5.4	2.2
Koraput	20.3	14.4	5.1	33.3	22.2	9.1	8.3	-4.9	13.9
Ganjam	33.3	23.1	8.3	19.2	7.9	10.5	—	—	—
Puri	25.5	11.7	12.3	5.7	6.9	-1.1	42.5	24.5	14.4
ORISSA	19.3	11.6	6.9	17.8	10.7	6.4	19.9	6.8	12.3

(Cont'd)

Table 2B (Cont'd)

District	SMALL MILLETS			PULSES			OILSEEDS		
	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity
Sambalpur	1.7	1.6	0.1	-9.9	-12.9	3.4	12.0	6.0	5.6
Sundargarh	—	—	—	-26.2	-14.1	-14.1	-7.9	-7.9	-0.1
Keonjhar	—	—	—	19.8	0.7	19.0	14.0	8.0	5.6
Mayurbhanj	78.0	55.4	14.6	25.8	19.7	5.1	19.9	19.2	0.6
Balasore	—	—	—	22.6	25.9	-2.7	30.8	35.1	-3.2
Cuttack	15.2	20.7	-4.5	0.4	2.1	-1.7	13.5	3.8	9.3
Dhenkanal	14.4	9.5	4.4	11.7	-1.3	13.2	19.3	4.7	13.9
Baudh-Khondmals	3.3	6.9	-3.3	8.0	-3.2	-5.0	8.1	5.8	2.1
Bolangir	-5.7	9.0	-13.5	-12.2	-7.2	-5.4	-2.8	-5.6	3.0
Kalahandi	103.2	84.4	10.2	-13.0	-4.4	-9.0	-4.3	-4.9	0.5
Koraput	31.1	36.1	-3.7	4.3	9.8	-5.0	12.4	6.2	5.8
Ganjam	53.2	42.3	7.7	24.6	21.7	2.3	20.1	12.7	6.6
Puri	19.9	17.3	2.2	0.6	-3.5	4.3	24.7	13.7	9.7
ORISSA	14.9	19.7	-4.0	-0.9	1.3	-2.2	9.9	3.5	6.2

District	FIBRES			FOOD CROPS			NON-FOOD CROPS		
	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity
Sambalpur	-4.0	-1.1	0.2	3.1	0.7	2.3	10.6	4.7	5.6
Sundargarh	20.0	-8.6	31.4	-4.6	-2.3	-2.4	-0.1	-6.5	6.9
Keonjhar	4.5	6.0	-1.4	0.4	0.2	0.2	8.1	7.0	1.1
Mayurbhanj	4.2	6.8	-2.5	2.1	1.3	0.7	14.5	15.0	-0.5
Balasore	3.1	2.8	0.3	3.8	1.7	2.1	7.8	9.9	-1.9
Cuttack	1.4	-1.0	2.4	5.6	2.7	2.9	6.2	1.1	5.1
Dhenkanal	10.0	4.3	5.5	2.3	0.8	1.5	15.0	4.6	10.0
Baudh-Khondmals	9.8	25.2	-12.3	5.4	0.5	4.9	16.6	5.9	10.1
Bolangir	12.4	10.5	1.8	0.9	0.8	0.1	0.6	-3.2	3.9
Kalahandi	36.8	17.8	16.1	-1.3	0.9	-2.3	10.2	-2.5	2.8
Koraput	10.6	5.8	4.5	0.7	2.3	-1.6	8.0	6.6	1.3
Ganjam	11.7	10.5	1.1	5.6	6.5	-0.9	21.2	14.0	6.4
Puri	6.0	5.2	0.8	2.2	0.1	2.1	17.0	12.4	4.1
ORISSA	3.0	1.2	1.8	2.5	1.6	0.8	8:5	3.7	4.6

ANNEX IV

THE SCHEME OF DECOMPOSITION FOR THE COMPONENT ANALYSIS OF INCREASE IN OUTPUT

Minhas and Vaidyanathan[1] start with the following identities:

$$P_o = A_o \sum_i W_i \; C_{io} \; Y_{io}$$

and $$P_t = A_t \sum_i W_i \; C_{it} \; Y_{it}$$

where 'p' represents the aggregate value of output of the crops included and 'A' is the total area under the corresponding crops. C_i is the share of area under the i^{th} crop in the total area. Y_i and W_i denote the yield per acre and the price per unit respectively of the i^{th} crop. The subscripts 'o' and 't' stand for the base and the final period respectively. Subtracting the former identity from the latter and then simplifying (by substituting $[A_o + (A_t - A_o)]$ for A_t and so on) and rearranging the terms on the right-hand side of the equation, the authors get:

$$P_t - P_o = (A_t - A_o) \sum_i W_i \; C_{io} \; Y_{io} \qquad (1)$$

$$+ A_t \sum_i W_i \; C_{io} \; (Y_{it} - Y_{io}) \qquad (2)$$

$$+ A_t \sum_i W_i \; (C_{it} - C_{io}) \; Y_{io} \qquad (3)$$

$$+ A_t \sum_i W_i \; (C_{it} - C_{io}) \; (Y_{it} - Y_{io}) \qquad (4)$$

It may be observed that the terms (1) to (4) on the right-hand side describe the contributions of various components and the combinations thereof to the absolute growth of output. To illustrate, (1) represents area effect, i.e. the absolute increase in agricultural output exclusively due to the extension of cultivated area,[2] assuming that other variables (productivity and crop pattern) remain constant. (2) is the sum of the yield effect (i.e. increase in agricultural output on account of rise in physical yields per acre of various crops) and the interaction between area and yield effects.[3] Similarly, (3) is the area and crop pattern, while (4) is the sum of two interactions, the one between yield and crop pattern when cultivated area is kept constant and the other resulting from simultaneous changes in area, crop pattern and yield. Here, this scheme of decomposition has been modified by dividing each term by P_o and thus converting absolute growth into relative growth (which is more helpful in obtaining a comparative picture) so that the weights given to various crops in order to arrive at the aggregate effects become explicit.[4] We may rewrite this scheme in the following form where each of the seven[5] terms is given separately.

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[1] *Op.cit.*

[2] The area effect is identified on the assumption that the additional area is of the same quality (i.e. productivity potential) as that already under cultivation. In other words, a one-to-one correspondence between area and output is implied.

[3] This can be shown by substituting $(A_o + (A_t - A_o))$ for A_t in (2). Thus,

$$A_t \sum_i W_i \; C_{io} \; (Y_{it} - Y_{io}) = A_o \sum_i W_i \; C_{io} \; (Y_{it} - Y_{io}) + (A_t - A_o) \sum_i W_i \; C_{io} \; (Y_{it} - Y_{io})$$

While the first term on the right-hand side takes into account the variation in physical yields, only the second considers changes in both area and yields.

[4] For example, taking the absolute yield effect and dividing it by P_o, we get:

$\frac{A_o}{P_o} \sum_i W_i \; C_{io} \; (Y_{it} - Y_{io})$ which when divided and multiplied by Y_{io}

can be written as: $$\frac{A_o}{P_o} \sum_i W_i \; C_{io} \left[\frac{(Y_{it} - Y_{io})}{Y_{io}} \right] Y_{io}$$

$$\sum_i \left[\frac{Y_{it} - Y_{io}}{Y_{io}} \cdot \frac{A_o \; W_i \; C_{io} \; Y_{io}}{P_o} \right] = \frac{Y_{it} - Y_{io}}{Y_{io}} \cdot \frac{P_{io}}{P_o}$$

where P_{io} denotes the value of output of the ith crop in the year 'o', so that $\sum_i P_{io} = P_o$.

[5] There are seven terms in all because, out of the three variables (viz. total cultivated area, yields per acre and shares of different crops in area), we first allow only one of them to change, keeping the other two constant, and thus yielding $_3C_1 = \frac{3!}{1! \; . \; 2!} = 3$ terms. Finally, all the three factors are allowed to vary at a time, giving $_3C_3 = \frac{3!}{3!} = 1$ term.

$$\frac{P_t - P_o}{P_o} = \frac{A_t - A_o}{A_o} + \sum_i \left[\frac{Y_{it} - Y_{io}}{Y_{io}} \bullet \frac{P_{io}}{P_o} \right] + \sum_i \left[\frac{C_{it} - C_{io}}{C_{io}} \bullet \frac{P_{io}}{P_o} \right]$$

$$+ \frac{A_t - A_o}{A_o} \bullet \sum_i \left[\frac{Y_{it} - Y_{io}}{Y_{io}} \quad \frac{P_{io}}{P_o} \right] + \frac{A_t - A_o}{A_o} \bullet \sum_i \left[\frac{C_{it} - C_{io}}{C_{io}} \bullet \frac{P_{io}}{P_o} \right]$$

$$+ \sum_i \left[\frac{Y_{it} - Y_o}{Y_{io}} \bullet \frac{C_{it} - C_{io}}{C_{io}} \right] + \frac{A_t - A_o}{A_o} \bullet \sum_i \left[\frac{Y_{it} - Y_{io}}{Y_{io}} \bullet \frac{C_{it} - C_{io}}{C_{io}} \right]$$

However, we have maintained the system adopted by Minhas and Vaidyanathan of lumping the pure effects with appropriate interaction terms. Assuming that rise in yield per acre (obtained by dividing the total output by total area) is the same on the additional land as on that already under cultivation (and not that the new area has any intrinsic property contributing to higher productivity), the interaction between area and yield effect is legitimately combined with the pure[6] yield effect. Similarly, the interaction between area and crop pattern is lumped with the pure crop pattern effect. Since it is not obvious where the interaction between yield and crop pattern or that among all the three variables properly belongs, they have been lumped together and called "the interaction term".

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[6] A "pure" effect is the estimated contribution of the change in a single factor to growth of total output, the other two variables being kept constant.

ANNEX V

THE CONCEPT OF POPULATION PRESSURE

1. Introduction

Since land is an important limiting factor in agricultural development, the status of agricultural communities is often defined in terms of their land-man ratio. Where the land-man ratio is unfavourable, the community is considered to be suffering from "population pressure". Recently, Easterlin has drawn attention to two major difficulties in the use of this concept":

> "First, it is asymmetrical. At any given time, there are typically some areas which are not experiencing population pressure — how does one classify and differentiate among these areas? The term "population pressure", which is essentially negative in connotation, does not clearly have an opposite with positive connotation. Second, the term is often conceived in some absolute sense, as though it were relevant only to situation of clear-cut poverty.....If one recognizes the possibility of variations in living level aspirations among different places, then it seems possible that "population pressure" may be experienced in situations which have quite different absolute levels of living. Thus, even though absolute living levels are high, if desired living levels are even higher, the situation may be one of "population pressure".[1]

To minimize the above difficulties, Easterlin has suggested replacement of the concept of "population pressure" by that of "economic stress", defined as the relation between level of living requirements or aspirations and income-producing possibilities. When realization of desires is difficult, stress is experienced; when realization of desires is easy, there is an "economic opportunity".

To provide an empirical measure of the concept, Easterlin has adopted Lorimer's approach[2] which outlines how the economic implications of demographic behaviour could be assessed in terms of the balance between consumption and production in different phases of the life cycle of a family. To translate this approach in macro-terms, we may estimate the additional consumption requirements arising from the formation of new households by young adults as they marry, raise families and lead independent lives. The product of the number of males reaching family-forming age in a given period and the average consumption standard is one measure of the additional consumption requirements generated during a particular period in a given area. Alternatively, the number of males entering the labour force during a given period may be multiplied by the average earnings in the initial year to get a measure of the additional output required to maintain the existing level of economic equilibrium. On the supply side, the income potential for a farming community in a given area could be measured by the product of yield per hectare (or acre) and the amount of land available to the entrants to the labour force.

Where the additional output requirements exceed the income-producing possibilities, there is "economic stress", while the reverse situation is one of "economic opportunity". Equality between the two implies a sort of economic equilibrium. The concept thus defined has obvious implications for the dynamics of population growth. "Economic stress" might bring about a low rate of population growth, while "economic opportunity" might accelerate it. Assuming the Malthusian principle to operate, the causal mechanism for either situation would be variations in birth and death rates. Where birth rates are close to the biological maximum and the course of mortality is by and large independent of economic development, the principal mechanism through which economic opportunity would be experienced is migration. Needless to say, technical progress and institutional changes might significantly modify the process and even alter the direction of population movements.

The dynamic implications of "economic stress" or "economic opportunity" suggested above presuppose that the initial level of *per capita* consumption or, in the alternative formulation, average earnings per worker in the base period truly express the living aspirations or income expectations of those involved. If the initial average earnings of the existing labour force actually fall short of its aspirations, there is disequilibrium which may be further aggravated over time if the area becomes one of potential "economic stress". What is termed "economic opportunity" may only turn out to be a means of correcting the initial disequilibrium. Thus, even in an area which seems to have "economic opportunity," the prospective migrants may have to face tough competition from those already there. It is from this point of view that a close examination of the existing relation between the number of people and the resources already in use also acquires significance in overcrowded, less developed countries.

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[1] R.A. Easterlin, "Effects of agrarian population pressure" paper prepared for United Nations ECAFE Meeting of National Team Leaders of the Comparative Study of Population Growth and Agricultural Change, Bangkok, April, 1971.

[2] Frank, Lorimer. "The economics of family formation under different conditions" in *World Population Conference, 1965,* (New York, United Nations, 1967).

To allow for variations in the extent of land utilization and dependence on agriculture the average land-man ratio or net sown area per worker in agriculture, would indicate the balance between population and resources in a farming community at a point of time. Such a static measure may seem a less promising analytical instrument than the dynamic concept outlined above. All the same, the analytical signifiance of this concept should not be underrated. The balance between agricultural workers and cropped area at any time is the end product of a long process of both demographic and agricultural evolution. In the absence of structural changes in the economy, continued increase in numbers would tend to reduce cultivated land per worker. However, if population increase is the major force in the exploitation of agricultural potential, one would expect an increase in human effort induced by the sheer survival instinct. This would lead to an increase in the percentage of net sown area to arable land, greater intensity of cropping, better land utilization and higher yields per acre. If, on the other hand, a smaller net sown area per worker coexists with unused production potential, it would suggest that forces other than spontaneous human effort are needed to promote further expansion of acreage. In India, where the State now supplements individual enterprise, a comparative study of trends in such areas before and after the advent of planning would be interesting both in itself and as a means of unravelling causation, particularly the relative contribution of spontaneous forces and policy measures.

2. Measurement of population pressure

The static measure of population pressure outlined above is easy to compute. The area already under cultivation may be taken as a rough measure of the existing production possibilities for a farming community. Refinements could be made for differences in the quality of the soil, rainfall and irrigation. In the absence of knowledge about the precise relationship between these factors and productivity, appropriate adjustments on this account are not possible. Output actually realized in the base period, however, does take into account these and other elements to a certain extent and may, therefore, provide a measure of the population-supporting capacity of a region. Assuming an equilibrium situation at the state level, average output per person on the farm at the state level could be used as the "norm" by which the extent of disequilibrium, if any, in the different districts could be measured. In the absence of data on the farm population, the number of male workers in agriculture (assuming that there are no significant interdistrict variations in the number of other persons-non-workers and female workers per male worker in farm families) and the ratio between net sown area and male workers in agriculture in a district and at the state level would give a measure of the initial demographic-agricultural balance. An alternative formulation could be in terms of output per worker.

The empirical specification of the dynamic measure of "population pressure, or what is more appropriately termed "economic stress," is somewhat more complicated. According to Easterlin's approach, the consumption requirements are estimated as the product of the number of males reaching adulthood in a given period and the average consumption standard which is assumed to correspond to the existing level of agricultural output per unit of farm population. Income-producing possibilities are equated to available acres of land multiplied by average yield. The difference between consumption requirements and income-producing possibilities provides a measure of economic stress.

The simplified measure of economic stress outlined above

> "assumes that the average consumption standard and average yield are constant from one situation to another, or else change in compensating fashion. Under these circumstances, variations in consumption requirements from one situation to another will depend solely on differences in the number of males reaching adulthood. Similarly, variations in income producing possibilities will depend only on differences in the amount of land currently available for establishing a farm. As a result, difference in economic stress from one situation to another reduce to differences in the relation between the number of young males

Table 3. Illustrative computation of "economic stress", and "opportunity" in the districts of Punjab, 1951-1961

District	Rural males aged 5-14 in 1951	Expected entrants in agriculture: multiplied by percentage of rural male workers in agriculture	Arable land not utilized for cultivation (1951)	Land becoming available on account of deaths among agricultural workers	Available land potential (3) + (4)	Available potential per prospective entrant (5) ÷ (2) (LPE)	Net sown area per worker 1951 (acres)	Quotient of economic opportunity" (6) ÷ net sown area per worker (7) (QEP)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Hissar	134,890	117,354	1,120,400	317,078	1,437,478	12.25	9.7	1.26
Rohtak	151,550	112,147	247,700	154,932	402,632	3.59	5.3	0.67
Gurgaon	129,408	99,644	160,700	159,789	320,489	3.22	5.8	0.56
Karnal	142,882	108,590	718,700	144,927	863,627	7.95	5.0	1.60
Ambala	128,997	87,718	177,400	154,195	331,595	3.78	5.8	0.65
Hoshiarpur	148,552	112,900	126,300	133,635	336,881	2.30	4.5	0.51
Jullundur	135,249	89,264	150,000	107,334	267,334	2.88	4.4	0.65
Ludhiana	111,709	75,962	149,900	103,774	253,674	3.34	5.2	0.64
Ferozepur	170,738	146,835	519,700	263,338	783,038	5.33	6.8	0.79
Amritsar	182,862	138,975	251,300	156,290	407,590	2.93	4.1	0.72
Gurdaspur	120,712	85,706	119,400	72,990	192,390	2.24	4.5	0.65
Bhatinda	102,277	92,049	217,000	190,900	407,900	4.43	7.0	0.63
Kapurthala	41,597	34,110	152,600	30,801	183,401	5.38	3.4	1.58
Mahendragarh	56,628	52,098	110,700	84,111	194,811	3.74	6.2	0.61
Patiala	105,574	87,626	642,300	98,550	740,850	8.45	3.9	2.18
Sangrur	153,761	130,697	362,700	157,470	520,170	3.98	4.5	0.88
PUNJAB	2,136,608	1,687,920	5,499,000	2,455,431	7,954,431	4.71	5.3	0.88

reaching family-forming age and the available[3] number of farm sites, obtained as a quotient of the available land supply and the average farm size."

The method of computing "economic stress" in this study is illustrated in the table given above.

Since age at marriage is changing in Indian society and the rates at which new couples are either setting up independent households or continuing to live in the parent households are not precisely known, the number of prospective entrants into the labour force was taken as a proxy for the number of demanders for agricultural land. In India, close to 90 per cent of rural males enter the labour force by age 15. Rural males[4] who were aged 5-14 in 1951 (given in column (1) of table 3) and would attain and complete age 15 by 1961 were the expected entrants into the rural labour market between 1951 and 1961. It was assumed that the non-agricultural sector would continue to absorb the same proportion of new workers in the decade 1951-1961 as in 1951. Total rural males aged 5-14 in 1951, multiplied by the proportion of total male workers employed in agriculture in 1951, gives the number of persons who will demand agricultural land for their support in the decade 1951-1961 as shown in column (2) of the table.

On the supply side, arable land not utilized for cultivation (other uncultivated land and fallows), given in column (3), was taken as available land potential on the assumption that its reclamation was economically feasible. To this was added the land vacated by agricultural workers aged 15 and over in 1951 who did not survive till 1961 (column (4)). The probabilities of survival for each age-group were obtained from the census Life Tables for the western zone (for Punjab) and the eastern zone (for Orissa) and applied to the number of males in the corresponding age-groups in 1951 to get the numbers surviving until 1961. The difference between the number of males aged 15-59 in 1951 and the survivors of this group in 1961 (who were aged 25 to 69 in 1961) equals the number of deaths. This number multiplied by net sown area per male worker in agriculture in 1951 yields additional land for the prospective entrants (column (4)). The sum of columns (3) and (4) gives the total land potential, which, when divided by column (2) (expected entrants into agriculture), gives the potential land per prospective entrant into the work force in the decade 1951-1961 (column (6)). When column (6) is divided by net sown area available per worker in 1951 (column 7), the quotient of economic opportunity is obtained. The implicit assumption is that the output of cropped area in 1951 was just sufficient to meet the consumption requirements of the agricultural workers and their dependants. When the quotient is unity, there is zero stress; a quotient greater or less than unity suggests "economic opportunity" or "economic stress" respectively.

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[3] Easterlin, *op. cit.*

[4] Since female participation in economic activity is marginal and highly variable, rural females were omitted from the calculations.

A simpler formulation (and one that is frequently used) of population pressure would be potentially arable land per person of rural population, which is a kind of measure of population density. This would approximate the measure of "economic stress", assuming that the ratio of prospective entrants to the initial size of the agricultural work force does not vary significantly from one district to another.

In cases of inadequate data availability, rural density would be an easy measure of economic stress. As Easterlin, however, rightly observes: "the stress measure seems preferable since it relates more specifically to the situation of young adults... [**and**] lends itself to further inquiry into substantive conditions. Thus, a rise in aspirations and consequent increase in economic stress can be handled in the framework of the stress measure."[5]

As will be evident from the study of the relationships between alternative measures of population pressure and population growth in 1951-1961 in chapter III, available land potential per prospective entrant into the agricultural labour force (LPE) is a more relevant variable for explaining demographic behaviour, particularly net migration, than Easterlin's stress measure. This may also be established on the basis of *a priori* reasoning. Assume district "A" has an LPE of 7 acres and net sown area per worker at the initial time of 10 acres, while district "B" has an LPE of 4 acres and initial area per worker of 2 acres. While district "A" would classify as a district of "economic stress" and "B" as one of "economic opportunity", it would not be a rational response for farmers in district A with an LPE of 7 acres to move into district B, with an LPE of 4 acres.

On the other hand, it would appear reasonable for people to move from district B to district A, since the latter has a higher LPE, and for the migrants to ignore the relation that the LPE bears to the "needs" of farmers in district A (taking initial net sown area per worker as a proxy for their consumption needs). LPE, therefore, is a more meaningful dynamic measure of the population-resource balance for explaining variations in population movements. It may be divided by initial net sown area per worker at the state level (involving the assumption of uniform consumption standard in all districts) to convert it into the form of an index.

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[5] *Ibid.*

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E. Asian Population Programme News

A quarterly regional newsletter, published since 1971. Issues to date comprise Vol. 1, Nos. 1, 2, 3; Vol. 2, Nos. 1, and 2 and 3 (combined); Vol. 3, Nos. 1 and 2 (combined), Nos. 3 and 4 (combined); Vol. 4, Nos. 1, 2 and 3 (combined), No. 4; Vol. 5, Nos. 1, 2; and occasional special issues.

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